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ANNOUNCEMENT.

Beginning with the next volume of the ELECTRICAL REVIEW the date of issue will be changed from Wednesday to Saturday. The first issue, therefore, in January will be dated January 5. There will be no change in the date of going to press, all forms of the ELECTRICAL REVIEW being closed Monday evening as heretofore. Special communications and changes in running advertising should reach us not later than the Saturday previous. This is made necessary by the increase in the size of the ELECTRICAL REVIEW and in the number of its subscribers.

THE METRIC SYSTEM.

The committee of the House of Representatives in charge of the bill to substitute, in 1903, the metric system of weights and measures for the common system in use, has reported the matter favorably and there seems now good reason to believe that the bill will become a law.

It can not be denied that the metric system is the most simple and logical system of weights and measures that has yet been devised and the fact that it has already been adopted in most of the civilized countries of the world, and is in common use in them, makes the step taken by the House Committee one that should receive cordial approbation. At the same time it must be said that there are distinct drawbacks to the general introduction of this unfamiliar system, which, however, are probably more than compensated by its advantages.

To speak first of its disadvantages, the names of the units in the metric system are far too long and are uncouth and unfamiliar words to the great bulk of the English speaking people. It seems as if it might be possible to replace such terms as centimetre and kilogramme with short and concise terms better adapted to American organs of speech. Another difficulty that will seriously hamper the general introduction of the system is unfamiliarity with the sizes of its units. In other words, most of us have a fairly accurate idea of a pound, a foot, a square inch, but how many of American artisans, mechanics, engineers and trades-people have any accurate mental conception of a kilogramme or a centimetre? For a while, certainly, after the general introduction of the system both methods will obtain and people will translate from the unfamiliar into the familiar by remembering, for example, that a metre is a little more than a yard and a kilogramme something more than two pounds. In some of the remoter districts of this country to-day we still hear people speak of shillings and sixpence in ordinary commercial transactions. In other words, a century of decimal money has not entirely eliminated the remembrance of the older system. It will be very hard for some people to unlearn their conceptions of the standard units of measures and weights and to take on new ones, so it seems likely that at least a generation must pass before we will find ourselves thinking in terms of the metric units.

But perhaps the worst objection that can be urged against the metric system is that its units are of singularly inconvenient size. To replace the inch in common use with the centimetre means that most measurements that are used by carpenters, builders, mechanics, electricians and other such artisans will be expressed in long and cumbersome figures, while the metre is far too large a linear unit to be useful in these arts. It will, however, easily replace the yard in measurements of textile fabrics, etc. The kilogramme is rather large as a commercial unit for weight, but happily the metric ton is not far different from the ordinary British long ton that we are familiar with in the measurement of coal and other crude materials. The gramme is a unit so much smaller than the common ounce with which we have been familiar all our lives that it will doubtless find as little use in this country as it has in France. Again, the kilometre is so much shorter than the mile that figures of distances expressed in it look unreasonably large to eyes accustomed to the older method of measure. Worse than all of this, however, is the fact that no exercise of ingenuity so far has enabled the construction of screw-threads, wire-gauges, drill-gauges, sheet-metal gauges, etc., upon any decimal system based on the metric units. To this day in Germany, where the metric system is

in practically universal use, mechanics adhere to the Whitworth and Stubbs screw and wire gauges. This is for the simple reason that aliquot even subdivisions, according to the multiples of two, using the inch as a standard of length, seem to come out nearer what is desired in practice than any decimal multiplication or subdivision of any of the metric units so far attempted.

Looking, however, on the other side of the picture we see that the use of the inch and pound system is now confined wholly to English speaking countries and that our future career in the markets of the world will be no little limited by adherence to these units, which are as unfamiliar to our customers as their measures are to us. We will have, of necessity, in securing foreign trade to adapt ourselves to the standards set by an almost universal convention. If for no other reason than this the adoption of the metric system by the United States is a thoroughly good thing. The mental wear and tear incident to the use of our complicated and cumbersome present method will, of course, be eliminated, but this difficulty is more imaginary than real. We are prone to think in this country of the British system of money as the most complicated and unhandy that can be imagined, but the British have managed to worry along with it for a long time and seem to exhibit no signs of mental strains occasioned by using a complex and unscientific method of counting their money. On the whole, then, the metric system is good for us. There seems little reason to doubt that another generation will see us thinking and dealing in terms of its units. But it can not be believed that the American public will continue to use names four syllables long for them.

ELECTRICITY ON THE ISTHMIAN CANAL.

Whether or not Congress succeeds in disentangling itself from the snarl in which it has fallen regarding treaties and other matters in connection with a canal across the Isthmus of Panama, the canal will surely be built and built soon, because the trade of the world demands its immediate construction. This is not the place to argue the feasibility of one route or the other, and we have no occasion to advise concerning treaties, but a certain engineering feature of the canal proposition should strongly appeal to electrical interests. Along both the Panama and the Nicaragua routes are torrential streams fed from the copious rainfall of the tropics and able to furnish, if properly utilized, an abundant and enormous water-power. Neither canal would be very long. The consequence of this state of things is that nowhere in the world offers better opportunity for electric towage of vessels. A considerable proportion of the ships that will pass through the canal will be sailing vessels and they will require to be towed through. If steamers are used all the coal that they burn will have to be shipped to the Isthmus, and the nearest place at which good coal can be loaded for shipment there is the Chesapeake Bay. This means that steam coal will be very expensive, while at the same time the natural condition will make electric power very cheap. The canal will have to be lighted from end to end to make night navigation easy and altogether the problem of lighting it, of providing proper transmission lines and towing facilities, is one that is highly attractive and will doubtless prove very interesting.

Of course, once in a while, an electric automobile breaks down and has to be towed home. In New York city the manufacturers of such vehicles have large and powerful trucks which they use for this purpose, the disabled vehicle being hauled along unceremoniously behind by means of a rope. This is all very well as far as it goes, but the appearance of such a truck hauling a disabled vehicle on Broadway in the middle of the afternoon is liable to cause more or less critical comment on the value of electric vehicles in general. So long as broken down vehicles must be carried to the repair shop, would it not be wisdom for the towing trucks to avoid the most crowded thoroughfares and make their modest progress through the back streets; and at the same time would it not be an excellent idea to leave off of them the large and impressive signs announcing to what particular company they belong, so that the public might the more easily forget the fact that Smith's or Jones's evidently disabled electric vehicle had to be dragged home for repairs?

Some of our friends have taken exception to a statement we made in an editorial on the "Transpacific Cable" in the ELECTRICAL REVIEW for December 12, in which we said: "There is not a cable ship in the world flying the American flag." Literally, this statement is strictly true. As a matter of fact, however, the Government army transport service has had two cable ships, one of which now lies a wreck on Corregidor Reef, in Manila Bay. The other is the transport Burnside, which was fitted out last Summer in New York city as a cable ship and is now on duty in the Philippines laying cables to connect the more important islands of that group. Captain George O. Squier, of the Signal Corps, United States Army, is in command of the ship, and writes that she is particularly efficient for the work intended. It will thus be seen that while one of our army transports is fitted out as a cable ship, and is performing the service of a cable ship, she is carried on the army records as a transport.

A number of important electrical contracts for certain detail apparatus and supplies which will be required in the New York rapid transit subway have been let during the last few weeks, and it is understood that more contracts will soon be placed. The actual work of excavating the tunnel is proceeding with rapidity, and work is being carried on at several points. While it is legally still an open question what power will be used for the propulsion of trains through the tunnel, it is pretty well understood that electricity will be the selected power, from the fact that contracts involving material such as could be used only for electric transmission have been placed.

There is a constant and rapidly growing demand for an improved type of storage battery which will enable electromobiles to run further on one charge than is now possible. It is interesting to know that several new developments of this valuable piece of electrical apparatus are announced, and it is asserted by competent authorities that numerous improvements, both in the life and capacity of accumulators, have recently been made.

Science Brevities

The Origin of Terrestrial Magnetism—Mr. William Sutherland has put forward in a recent publication a theory of the earth's magnetism which is dependent upon the results attained in the experimental work of Rowland. In this it was shown that a moving electrostatic charge produced a magnetic field analogous to that produced by a current. If, then, the earth in its rotation about its axis carries with it an electrostatic field of force it would normally be magnetized with its axis of magnetization coinciding with its axis of rotation. While this is observed to be approximately true, it is suggested by the author that the variation of the magnetic poles is due to lack of symmetry in the magnetic permeability of the earth, and to the latter cause is ascribed also the induction of earth currents which in turn he believes to produce secular magnetic variations. For the daily variations the author accounts by the theory that under the action of the sun's rays the oxygen and ozone of the atmosphere become a sort of vast secondary battery, whose alternate charge and discharge give rise to displacing currents.

Cement for Electric Connections—The following formula for a metallic cement to be applied to wire joints by hand after the wires are twisted together without the use of heat, and for practical purposes taking the place of solder, is given in the *American Manufacturer*. The cement is an amalgam with which a binding material is mixed so that the mass has the consistency of putty. When put up in stick form it is said not to harden except at the surface where a crust is formed, and when the mass is worked in the fingers it becomes soft and plastic so as to be readily applied to the wires. The following ingredients are used in the proportions specified: Zinc, four parts; tin, two parts; copper, two parts; cadmium, two parts; bismuth, four parts; lead, two parts; antimony, one part; mercury, eight parts. The solid metals are granulated and melted together, after which the mercury is added, the mass being stirred at the same time. When cooled, it is pulverized in a mortar, and the binding material, consisting of liquid glucose or syrup and silicate of soda, is added in quantities sufficient to give it the consistency of putty. When spread out on a joint it is said to adhere tightly and to harden in 24 hours. No application of acid to the wires is necessary, and it is stated that the joint is well protected by the amalgam from oxidation. It should be taped in the usual way.

Electro-motive Force Due to Flow of Liquids in Tubes—In a recent bulletin of the Cracow Academy certain experiments of M. Constantin Zakrzewski on the electro-motive force produced by the motion of a liquid through a silvered glass tube are described. The tube in question was of capillary size and connected two large glass vessels partly filled with water, the electrodes terminating in the water a short distance from the ends of the tube. The flow of water was brought about by introducing compressed air into one of the vessels. The current of water was found to be accompanied by an electric current which depended for its direction upon the water current, and the electro-motive force was found to vary as the difference of pressures at the end of the tubes and also to depend on the distance of the electrodes from the ends of the tubes, the effect of increasing this distance, in the case of the electrode opposite the entering stream, being to decrease the electro-motive force. In the publication it is suggested that this result confirms an hypothesis of Helmholtz and Quincke, whereby electro-motive force has its origin in a variety of tearing action in the layers of contact electricity between the silvered tube and the water. The electro-motive force is dependent on the thickness of the silver, and decreases when the latter increases. When a solution of nitrate of silver is used in place of water the electro-motive force vanishes and changes sign when the concentration of the solution is equal to one three-thousandth of saturation.

The Production of High Temperatures—The paper read by Mr. E. D. Lange before the Paris meeting of the Iron and Steel Institute is of great interest to all engineers, although its particular applications deal with metallurgical operations, says the London *Electrical Engineer*. The author does not refer in this instance to the electrical furnace as a means for producing extremely high temperatures, but to the system invented by Dr. Hans Goldschmidt. This system, which is being experimented with largely at Essen, is not altogether new, and is based upon the heat of combination given off when aluminum is ignited in contact with certain metallic oxides. The author in his paper refers to the work which had been done previously on the same lines, particularly mentioning the work of Mr. R. A. Hadfield, who in 1895 succeeded in producing extremely pure iron by reducing ferrous oxide with aluminum. Dr. Goldschmidt's experiments were made with the object of discovering a mode of controlling the violent reaction obtained by the heating of aluminum in contact with metallic oxides, and these brought to light the important fact that it was not necessary to heat the whole mass up to the requisite temperature for ignition, but that it sufficed to start ignition at any one time. When combustion once started the reaction proceeded steadily with more or less speed throughout the whole mass, thus generating within itself the whole of the heat required. In the case of the refractory oxides, it would have been a difficult matter to apply the requisite heat for ignition at any point had not Dr. Goldschmidt made the still more important discovery that, although certain oxides combined with aluminum at so low a temperature that they could be ignited with an ordinary match, yet they nevertheless, in their combustion, develop so much heat that if a small quantity of these oxides was placed upon a mixture of refractory oxide and aluminum and ignited, a reaction was started in the same, which, thus originated, then proceeded automatically as before. The heat developed by the combustion of a mixture of alumina and iron is sufficient to start the reaction between the aluminum and iron oxide mixture, and as this proceeds, more and more of the same is added until within a minute or two there is a crucible containing reduced iron covered by a thick coating of alumina slag. On pouring off the slag, the temperature of the underlying liquid iron can be tried by pouring it on to a mild-steel plate or along the side of a mild-steel bar, when the hot iron cuts its way through with ease. Pyrometer experiments have established the temperature reached in the operation at between 2,900 degrees centigrade and 3,000 degrees centigrade, that is to say, 1,000 degrees centigrade more than that reached during the hottest period of the Bessemer blow. In the case of the reduction of chrome from its oxide by this method, the temperature of 3,000 degrees centigrade is certainly reached—a temperature hitherto obtainable by the electric arc alone. In the paper a system of welding together iron bars or rails was also described, in which the heat for the weld was obtained from the combustion of aluminum and iron oxide. It is estimated by Dr. Goldschmidt that it is commercially economical to connect in this way the rails of a tramway system, and he maintains that the cost of upkeep will be considerably less with joints made in this way. It would, of course, considerably increase the conductivity at the joints, and perhaps do away with the bonding which is now absolutely necessary.

THE THEORY OF ALTERNATING DYNAMO-ELECTRIC MECHANISMS—VIII.

BY W. ELWELL GOLDSBOROUGH.

The negative area is due to the lag of the current behind the impressed electro-motive force. The energy represented by this area is part of that stored up in the inductive portion of the circuit during the rise of the current, and it is therefore given back to the circuit again as the current decreases, since, as will be shown in a succeeding paragraph, the mean power exerted by the electro-motive force of self-induction during a period is zero.

To determine the equation of the power curve in Fig. 23, we have only to divide (66) through by $(d\,t)$, and obtain,—

$$e\,i = \frac{E\,I}{2}\cos\phi - \frac{E\,I}{2}\cos(2\,\omega\,t - \phi)$$

$$= \frac{E\,I}{2}\cos\phi + \frac{E\,I}{2}\sin(2\,\omega\,t - \phi + 90°). \quad (72)$$

The first right-hand member of this equation is a constant while the second is a pure sine function having double the frequency of the impressed electro-motive force: (72) is therefore the equation of a sine curve referred to a horizontal axis xx', raised a distance equal to $(EI \div 2)\cos\phi$ above the horizontal axis XX'. The area $Xxx'X'$ equals the energy developed by the alternator in one period (equals $[EIT \div 2]\cos\phi$) since the sum of the areas of the power curve on either side of the line xx' is zero.

The power curve is represented by the vector O'F revolving about O' as a centre in a clockwise direction 2 N times per second. To show the electro-motive-force current and power vectors in their initial positions, make $t = 0$; then OA will be in a horizontal position pointing to the left, OB will be ϕ degrees below the horizontal axis XX' and O'F will be 90 degrees minus ϕ above the horizontal axis xx'.

In Fig. 24 we have the energy curve plotted from the products of the instantaneous values of the electro-motive force necessary to overcome the electro-motive force of self-induction and the current. As previously stated the mean power exerted by this electro-motive force in a period is zero, and that this is true the figure clearly demonstrates, since the positive and negative areas are exactly equal. The positive area to the left is developed as the current rises from zero to its positive maximum and energy to the amount represented by this area is stored up in the magnetic fields of the circuit. As the current decreases from its positive maximum, and the lines of force within the coils die away, the electro-motive force of self-induction induced by them, acts in such a direction as to aid the current, and at the instant E becomes zero, E_l' does all the work of driving the current through the circuit. The energy it gives back to the circuit during this time is equal to the left-hand negative area.

In the same way, as the current rises in the negative direction, the right-hand positive area is developed, and energy is again stored in the fields by the current creating new lines of force in the coils; when the current dies away again the energy of the right-hand negative area is given back to the circuit.

Moreover, referring to equation (64), we see that the energy of the magnetic field is equal to,—

$$L\,i\frac{d\,i}{d\,t}\,d\,t = e_l\,i\,d\,t \quad (73)$$

$$= [L\,\omega\,I\cos(\omega\,t - \phi)]\,[I\sin(\omega\,t - \phi)]\,d\,t$$

$$= \frac{L\,\omega\,I^2}{2}\sin(2\,\omega\,t - 2\,\phi)\,d\,t \quad (74)$$

since

$$\sin 2\,\theta = 2\sin\theta\cos\theta. \quad (75)$$

Integrating (74) between the limits 0 and T,—

$$\int_0^T e_l\,i\,d\,t = \frac{L\,\omega}{2}\,I^2\int_0^T \sin(2\,\omega\,t - 2\,\phi)\,d\,t$$

$$= \frac{L\,\omega}{2}\,I^2\left[\frac{T}{0} - \frac{1}{2\,\omega}\cos(2\,\omega\,t - 2\,\phi) = 0, \quad (76)\right.$$

we have, therefore, both graphical and analytical proof that the *mean power exerted by the electro-motive force of self-induction in a period is zero.*

The value of the energy stored up in a magnetic field during the rise of the current from zero to a + maximum, or the energy represented by *one* of the positive areas in Fig. 24, is obtained from equation (74) by integrating between the limits 0 and $T \div 4$. Equation (76) then becomes,—

$$\int_0^{T\div 4} e_l\,i\,d\,t = \frac{I^2 L}{4}\left[\frac{T\div 4}{0} - \right.$$

$$\cos(2\,\omega\,t - 2\,\phi) = \frac{1}{2}\,I^2\,L. \quad (77)$$

The equation of the power curve in Fig. 24 can be obtained from equations 73 and 74 by dividing through by $d\,t$. From these the instantaneous value of the energy of the inductive portion of the circuit is equal to

$$e_l\,i = \frac{L\,\omega}{2}\,I^2\sin(2\,\omega\,t - 2\,\phi). \quad (78)$$

This is the equation of a sine function having double the frequency of the impressed electro-motive force. As it contains no constant term, the function is symmetrical about the same horizontal axis as the current, and is represented by the vector OG, which revolves about O, Fig. 24, as a centre, 2 N times per second. At the instant that $t = 0$, OG lags ϕ degrees behind OB.

In Fig. 25 we have the power curve derived from the curve of the effective electro-motive force E_r and the current curve. Since the current and electro-motive force are in phase all the products of their instantaneous values are positive, and therefore there is no negative work area; all the power represented by the power curve is spent in *doing* work.

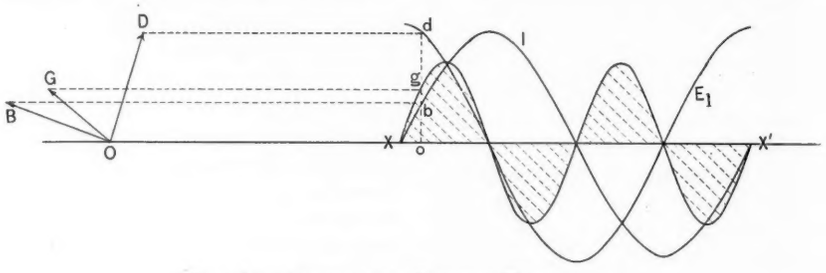


FIG. 24.—ALTERNATING-CURRENT MECHANISMS.

The equation of the energy included within the shaded area can be obtained from (64) by integrating the first right-hand member of the equation between the limits 0 and T, for,—

$$r\int_0^T i^2\,d\,t = I^2\,r\int_0^T \sin^2(\omega\,t - \phi)\,d\,t \quad (79)$$

$$= I^2\,r\left[\frac{T}{0}\frac{t}{2} - \frac{\sin(2\,\omega\,t - 2\,\phi)}{4\,\omega} = \right.$$

$$\left.\frac{I^2\,r}{2}\,T\right] \quad (80)$$

since

$\cos 2\,\theta = 1 - 2\sin^2\theta$, and therefore (81)

$$\sin^2\theta = \frac{1}{2} - \frac{\cos 2\,\theta}{2}. \quad (82)$$

Since (80) is a measure of the energy imparted to the circuit, i. e., dissipated as heat in the conductors during *one* period, by dividing by T we get,—

$$\text{The mean power} = P = \frac{I^2\,r}{2}\ \text{watts}, \quad (83)$$

as the equation of the power developed in the circuit.

It is well to notice here that since

$$I = \frac{E}{\sqrt{r^2 + L^2\,\omega^2}} \quad (54)$$

$$I\,r = E\,\frac{r}{\sqrt{r^2 + L^2\,\omega^2}} = E\cos\phi \quad (84)$$

and that equations (70) and (83) are therefore identical.

The equation of the power curve in Fig. 25 is obtained from equation (79). Dividing this expression by $d\,t$ it becomes,—

$r\,i^2 = I^2\,r\sin^2(\omega\,t - \phi)$, and by substitution from (85)

$$(82) \quad = \frac{I^2\,r}{2} + \frac{I^2\,r}{2}\sin(2\,\omega\,t - 2\,\phi + 90°) \quad (86)$$

since

$$-\cos(2\,\omega\,t - 2\,\phi) = \sin(2\,\omega\,t - 2\,\phi + 90°).$$

This equation, like (72), is an expression made up of a constant term $[I^2\,R \div 2]$, and a sine function $[(I^2\,r \div 2)\sin(2\,\omega\,t - 2\,\phi + 90°)]$ having double the frequency of the impressed electro-motive force. Moreover, since by equations (70) and (83) the constant terms in (72) and (86) are equal, (86) is also symmetrical about the axis xx'. The area $Xxx'X'$ in Fig. 25 is therefore equal to the area $Xxx'X'$ in Fig. 23.

When the sine in (86) is equal to +one, the power developed by the alternator will be a maximum and equal to twice the *mean power*, and when the sine has the value — one the power developed will be zero. In Fig. 25 the vector O'H, which revolves in a clockwise direction about O' as a centre 2 N times per second, represents the function expressed in equation (86).

If now we refer to equation (64) we find that the total energy dissipated as heat in any non-inductive circuit during any time $(d\,t)$ is proportional to the square of the corresponding instantaneous value of the current, since when L = 0, (64) reduces to,—

$$e\,i\,d\,t = i^2\,r\,d\,t. \quad (87)$$

The average rate, then, at which energy is dissipated as heat in a non-inductive circuit is proportional to the mean of all the $(T \div d\,t)$ squares of the current taken during one period.

If we divide both sides of equation (80) by $r \times T$ it reduces to,—

$$\int_0^T \frac{i^2\,d\,t}{T} = \frac{I^2}{2} \quad (88)$$

and we find that the *mean square value* of the current is equal to one *half the square of the maximum value* of the current, and this mean-square value of the current equals the rate at which energy is dissipated in a non-inductive circuit having a resistance of 1 ohm.

The *square root* of the mean square of an alternating current is an important quantity. It is called the "*virtual*" value of the current, since the *heating and power effects* produced in an alternating-current circuit, whatever be the wave form of the current present, are *proportional* to the *square* of the *virtual value* of the current.

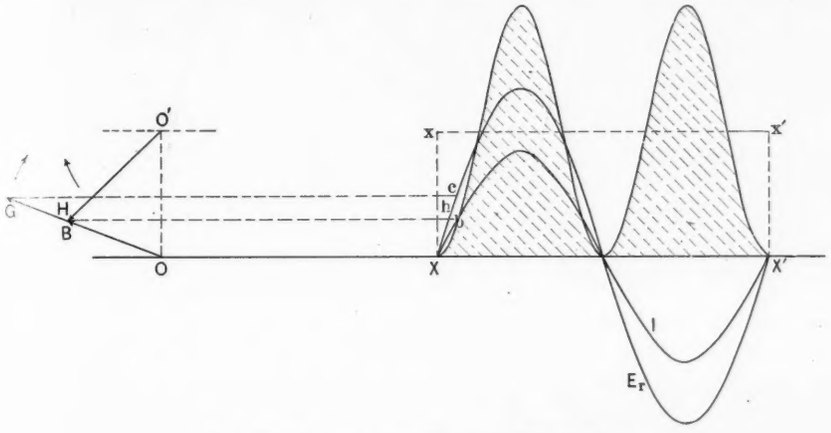


FIG. 25.—ALTERNATING-CURRENT MECHANISMS.

In the above considerations the inductive effects have been disregarded as the *average energy* expended in overcoming the *true* inductive electro-motive force is *zero*.

From equation (80),—

$$\text{the [mean]}^2 \text{ of } i = \frac{I^2}{2},$$

therefore

$$\text{the } \sqrt{[\text{mean}]^2} \text{ of } i = \frac{I}{\sqrt{2}} = .707\,I \quad (89)$$

$= \overline{I}$, the virtual value of the current.

Again, in any non-inductive circuit,—

$$i = \frac{e}{r},\ i^2 = \frac{e^2}{r^2},\ \text{and } i^2\,r = \frac{e^2}{r},$$

and when $r = 1$, e^2 = the rate at which energy is dissipated in the circuit. In this case, then, the average rate at which energy is dissipated in the circuit during a period, is equal to the mean square of (e) and, therefore, as in the case of the current, the effective value of an alternating electro-motive force is its *virtual* value or the square root of the mean of its squares. Therefore

$$\text{the } \sqrt{[\text{mean}]^2} \text{ of } e = \frac{E}{\sqrt{2}} = .707\,E \quad (90)$$

$= \overline{E}$, the virtual value of the impressed electro-motive force.

If we introduce the virtual values of the impressed electro-motive force and current into equations (70) and (83) we will have,—

$$\text{The mean power} = P = \overline{E}\ \overline{I}\cos\phi \quad (91)$$

$$= \overline{I}^2\,r. \quad (92)$$

In the case of air core solenoids what has been said above covers the whole ground, but in the case of electro-magnets having iron cores, although the electro-motive force of self-induction properly speaking exerts no power in a period, it still happens that these cores become warm when subjected to the influence of alternating magneto motive forces. To some degree this heating is due to conduction from the magnetizing circuit, but to a greater degree it is due to the friction of the molecules of the metal during their reversal with the change of magnetism and to the foucault currents set up in the iron. It is certain that if there be any electro-motive force doing work, its projection on the line of effective electro-motive force can not vanish; and if any work is done upon the cores by the changes of polarity in one period, the effective electro-motive force will be diminished by the amount of one opposite to it in phase and of such a value that if multiplied by the diminished current, the result will be the power producing the work observed to be done upon the cores. Such an electro-motive force is an induced one, but differs from that of self-induction, as usually understood, in having its phase in exact opposition to that of the current or lagging behind it 180° instead of 90°. In such a case the diagram of electro-motive forces would be as represented in Fig. 26.

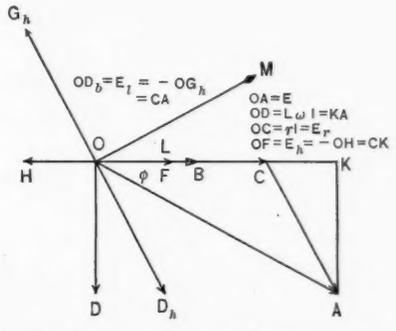


FIG. 26.—ALTERNATING MECHANISMS.

In Fig. 26,—

OA = the impressed electro-motive force.

$OC = r\,I$, the electro-motive force that overcomes the ohmic resistance of the circuit.

$OD = L\ \omega\ I$, the electromotive force that overcomes the actual inductance of the circuit.

$OF = E_h$, the electromotive force necessary to provide the energy consumed by hysteresis and foucault currents,

and OD and OC are connected by the relation $OD : OC :: KA : OC :: I\omega : r$.

The tangent of the angle of lag of the current behind the impressed electro-motive force is equal to,—

$$\frac{OD}{OK} = \frac{L\,\omega\,I}{r\,I + E_h} = \frac{L\,\omega}{r + r_h} = \tan\phi, \quad (93)$$

where $r_h = E_h \div I =$

(the watts dissipated in heating the core) ÷ (the current)^2,

= the equivalent foucault-current-hysteretic resistance.

Now $\frac{L\,\omega}{r+r_h}$ is less than $\frac{L\,\omega}{r}$, therefore one effect of the core losses is to diminish the angle of lag of the current.

It is also noticeable that the core losses, since they have the effect of a resistance, reduce the value of the current, and therefore the value of the effective electro-motive force, $r\,I = E_r$. The electro-motive-force vector $OK = OC + OF =$ the projection of the impressed electro-motive force upon the current, and the product of $OB \times OK = EI \cos\phi$, and is *proportional* to the power absorbed in the whole circuit.

The electro-motive force of self-induction of this circuit is $OG = E'_l$, which is equal and opposite to $OD_h = E_l$, and OD_h is the resultant of OD and OF, therefore, when hysteresis and foucault current losses are present,—

$$E_l = \sqrt{E^2_h + L^2\,\omega^2\,I^2} = I\sqrt{r^2_h + L^2\,\omega^2} \quad (94)$$

or the value of the inductive electro-motive force is increased. Here the electro-motive force of self-induction is *not* at right angles to the current but lags behind it *more* than 90°, for

$$\text{the angle } COG_h = 90° + \tan^{-1}\frac{KC}{AK} = 90° + \tan^{-1}\frac{E_h}{L\,\omega\,I} = 90° + \tan^{-1}\frac{r_h}{L\,\omega}. \quad (95)$$

Now the electro-motive force of self-induction is an induced one, and is dependent upon the magnetization of the cores. But the magnetism is always 90° in advance of the electro-motive force it induces, and will, therefore, be represented by a vector OM drawn at right angles to OG_h. When core losses are present then the current and magnetism are not in phase, but the *magnetism lags behind the current*. This angle COM is equal to the angle CAK, therefore

$$\text{the tan of COM} = \frac{r_h}{L\,\omega}. \quad (96)$$

One of the chief effects of hysteresis is to distort the shape of the current curve to forms analogous to that of the curve in Fig. 9, page 508. When this distortion is present equation (70) will not represent the mean power of the circuit accurately and an exact determination can only be made by integrating the power curve determined from the instantaneous values of (e) and (i).

In order to more perfectly elucidate this point let us consider a set of practical conditions. Suppose that we have determined the instantaneous values of the electro-motive force and current developed by an alternator through a complete period, by the application of the "rotary contact" experimental method to the machine. Table 1 contains a tabulated statement of the results so obtained.

TABLE 1.

Degrees.	E. M. F. e	Cur. i	ei	e^2	i^2
0	0	—30	0	0	900
15	26.5	— 9	—238	702	81
30	50	10	500	2500	100
45	70.5	22	1551	4970	484
60	86	30	2580	7396	900
75	96.5	35.5	3408	9312	1260
90	100	42	4200	10000	1764
105	96.5	51	4920	9312	2600
120	86	60	5160	7396	3600
135	70.5	65	4580	4970	4225
150	50	62	3100	2500	3842
165	26.5	49	1300	702	2400
180	0	30	0	0	900

The frequency = N = 100, therefore the period = T = .01 second.

In Fig. 27 these results are shown graphically; the curves are designated by the symbols that appear at the heads of the columns in Table I, and are plotted to the following scales:

Time, — one unit of length = .00166 second.

Electro-motive force, — one unit of length = 40 volts.

Current, — one unit of length = 40 amperes.

Watts, — one unit of length = 2000 watts.

Electro-motive force^2, — one unit of length = 2000 "square" volts.

Current^2, — one unit of length = 2000 "square" amperes.

One unit of length = three-quarters of an inch.

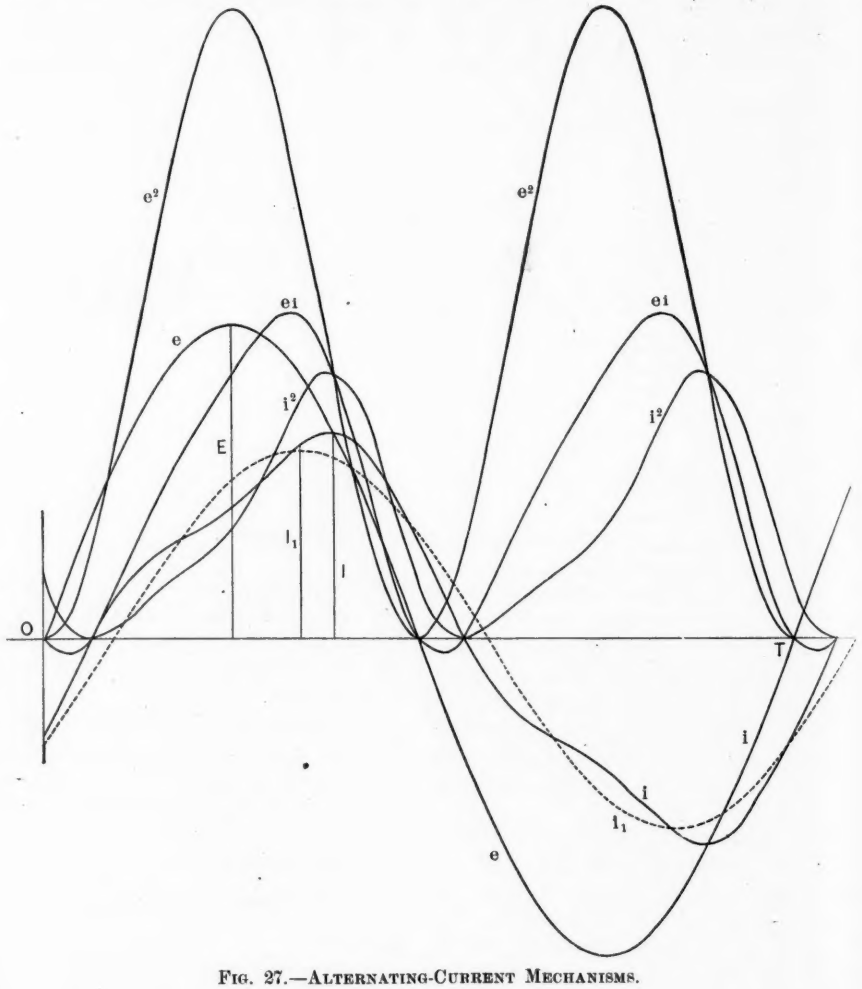
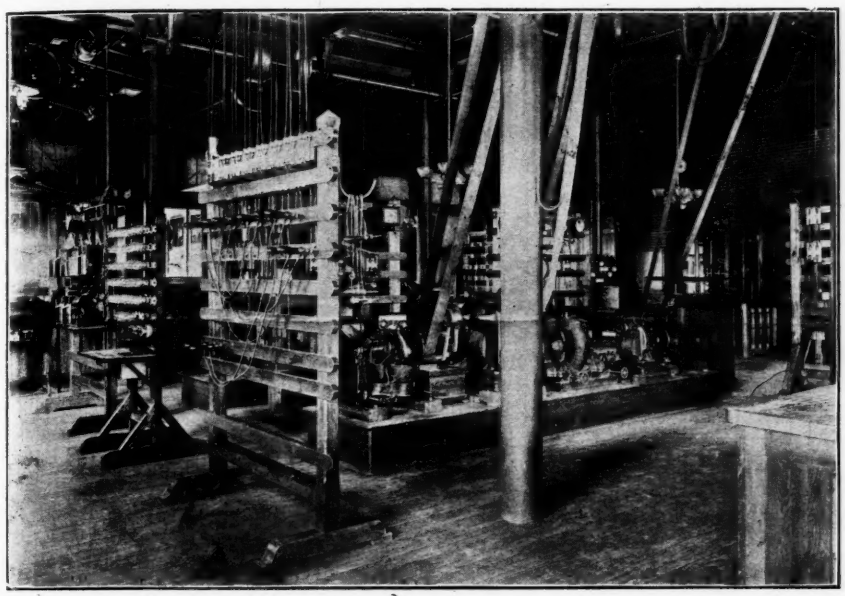


FIG. 27.—ALTERNATING-CURRENT MECHANISMS.

The Dynamo Laboratory of the Armour Institute of Technology, Chicago.

Among the educational institutions of Chicago, the Armour Institute justly lays claim to a high place, on account of the fact that it is thoroughly practical in its teachings and has already greatly assisted many young men in obtaining means of livelihood through technical work of various sorts. Among its courses none receives more particular consideration than electricity. The accompanying illustrations represent the dynamo laboratory of the Institute, which has been fitted up with special reference to the study of electrical machinery from a commercial as well as from a theoretical standpoint.



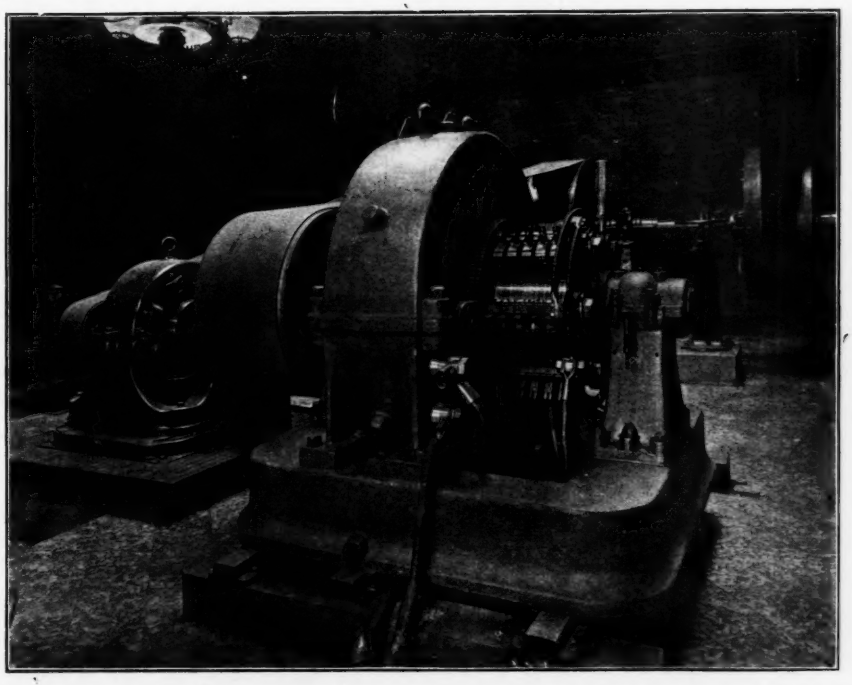
A View in the Electrical Engineering Laboratory of the Armour Institute of Technology, Chicago.

In purchasing machinery, ease of manipulation has been sacrificed somewhat in order to put the student in actual contact with that with which he will have to deal in his future career. Although the testing of large units is more difficult and somewhat more expensive, they have been selected on account of the greater value of results when obtained.

The electrical equipment of the Institute consists of about 20 motors and dynamos, representing about 10 standard types. The plant furnishing power has a capacity of 1,400 amperes direct current and 500 amperes alternating. The laboratory proper is driven by a 30-horse-power Westinghouse multipolar motor, belted to a countershaft from which the other machines are driven. Belted to the same countershaft is a 20-horse-power motor giving a driving capacity, when necessary, of 50 horse-power.

The driving of the machinery by motors gives a wide range of speeds as well as very close adjustment of the same. Both 25, 66 and 133-cycle single-phase alternating power is available, and by varying the prime mover all intermediate cyclic speeds can be obtained. Twenty-five-cycle two and three-phase power is also provided, and the laboratory, on the completion of a specially designed machine, will also have 66 and 133-cycle two and three-phase power. Two and three-phase rotary converters, generators, synchronous and induction motors are provided, all of them ranging from 10 to 20 horse-power. The equipment includes both the closed and the open coil types of arc dynamos. The transformer list ranges from 1 to 20-kilowatt capacity. Provision is also made for high-potential insulation tests. For this purpose the Institute is provided with one transformer giving 40,000 virtual volts and another 100,000, both of 25-kilowatt capacity.

In connection with the regular laboratory work each student is required to take practical charge of the Institute plant and equipment for a certain length of time, to operate the engines and dynamos and be responsible for the entire equipment. It is the aim to not only give a student a knowledge of machinery, but to drill him in the confidence and judgment required in the operation of it. Also in connection with the laboratory work inspection visits are made throughout the year. A study is made of power plants, commercial lighting and isolated stations, as well as machine driving and other industrial applications. Manufacturing methods are studied through inspections of large manufacturing firms located in the city. Perhaps in no city in the country, with the possible exception of New York, can such a wide variety of gigantic electrical applications be found as in Chicago. This advantage is thoroughly appreciated by the students of the Armour Institute of Technology. These visits are made use of in gathering data for dynamo, motor and station design, which is also a part of the senior work, as well as in becoming familiar with general applications of electrical power. In every way possible the student is made an electrical engineer in reality as well as in theory.



Direct and Alternating-Current Dynamos at the Armour Institute of Technology.

THE PLANT OF THE ST. CROIX POWER COMPANY, OF WISCONSIN—III.

BY HENRY FLOY.

The use of six-phase transformers and converters is novel. The reason for the adoption of six phases instead of three phases was to secure the advantages of reduction of copper losses in the armature, and the accompanying reduction of temperature and its better distribution. At first sight it might seem that the increased complexity involved in the use of six phases would not counter-balance the advantages to be gained. Practically, however, the use of six rings and the necessary additional taps to the windings on the armatures amounts to nothing in the operation of the machines. The dividing of the secondary windings on the transformers for two independent circuits results in no complication or expense. On account of the large current, the use of six conductors between the transformers and switchboard and between the switchboard and rotaries, was necessary whether three-phase or six-phase machines were installed. The switchboard is practically the same for either number of phases, except that the number of main switches was increased from two to three. This disadvantage, however, may be disregarded when a decided increase in the capacity of the rotaries is secured. The rotaries are ordinarily started from the direct-current end but are equipped with breakdown field switches and designed for starting from the alternating-current end where necessary.

Fig. 12 illustrates the alternating-current switchboard, which is about 35 feet in length and eight feet in height.

On the extreme left is a relay panel through which current is usually distributed by means of four-conductor cables to one of the old steam generating plants. This plant will be used as a relay station and in case of a breakdown in the water-power transmission plant, current will be supplied from it to the sub-station. The second panel from the left is a transformer panel connecting either set of the static transformers supplying current for alternating-current distribution to either of the two sets of four bus-bars. Each two-phase circuit is provided with two ammeters, two recording wattmeters, a four-pole oil switch and fuses. On this panel are also eight small double-pole switches, each of which controls the current to the magnets releasing the latches of three of the 25,000-volt switches.

The panel next adjacent on the right controls the power distributing two-phase circuit. The five following panels each control two single-phase alternating-current lighting circuits. Each of these panels is provided with an ammeter, automatic oil circuit-breaker and oil switch in series with plug switches. There will be noticed a number of holes in these panels which are designed for the plug switches, permitting the plugging of any single-phase feeder onto any pair of the eight bus-bars. The double-pole plugs used are shown in the illustration lying in a pile at the foot of two of these panels.

Next come six alternating-current rotary panels supplying current at 78 volts to the alternating-current end of the rotary converters. These panels are provided with three two-pole switches for the six-phase circuit, also indicating wattmeter and main ammeter, thus giving an indication of the power factor of the load. There is also the handle of the field rheostat, a direct-current starting switch, double-pole, double-throw field-switch, synchronizing plug and lamp and a small direct-current two-pole, double-throw switch controlling the motor actuating the six-phase inductor regulators. The inductor regulators are placed on the floor directly behind the alternating-current rotary panels.

The extreme right-hand panel contains a double-throw direct-current switch, a starting rheostat switch and an automatic circuit-breaker, through which is supplied and controlled the direct-current from the Edison system used in separately exciting and starting the rotary converters. On this panel there are also three multipoint voltmeter switches, through the use

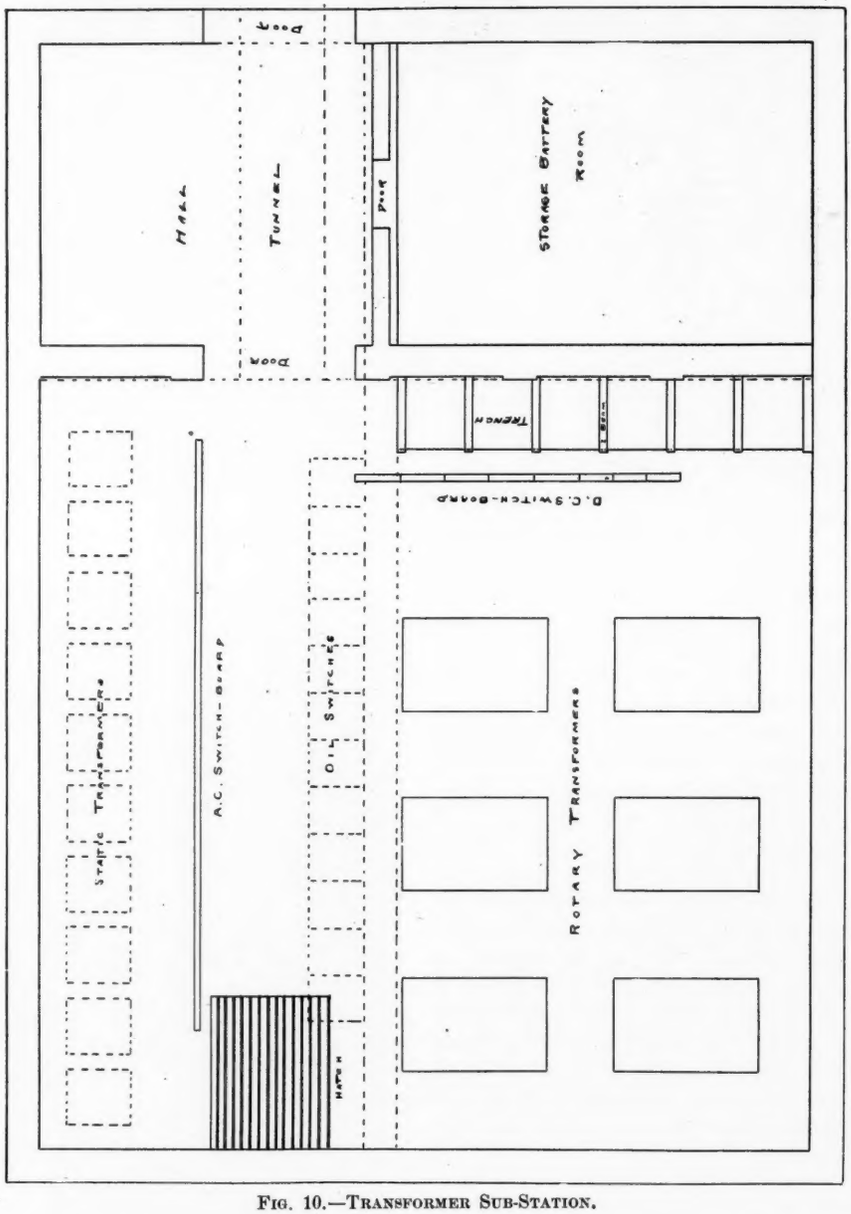


FIG. 10.—TRANSFORMER SUB-STATION.

of one of which the voltage of any of the Edison feeders or rotary converter bus-bars at the other switchboard (see Fig. 10) may be shown on the direct-current panels permit the reading of the potential of any of the alternating-current feeders or alternating-current end of the rotary converters.

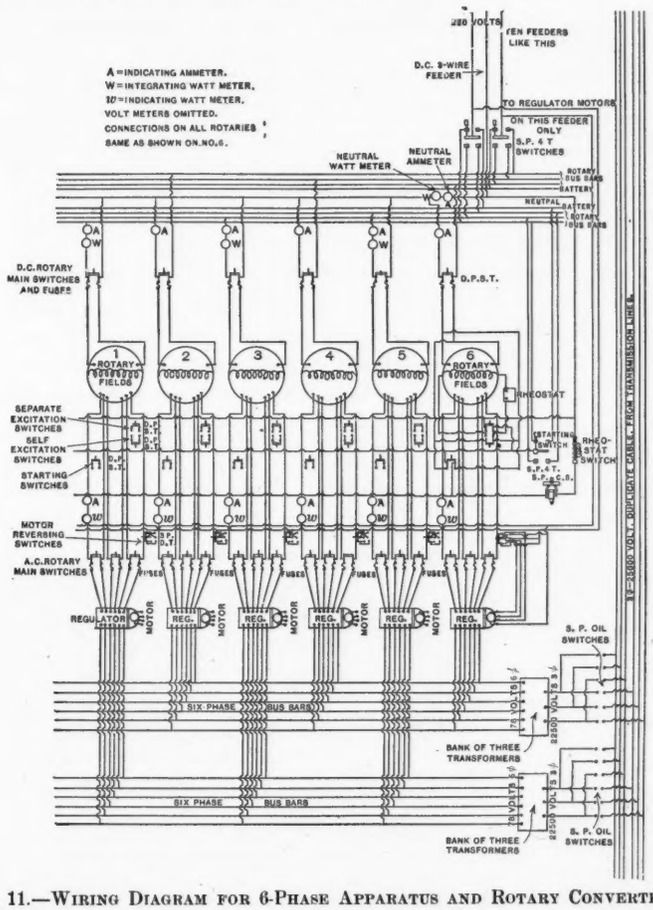


FIG. 11.—WIRING DIAGRAM FOR 6-PHASE APPARATUS AND ROTARY CONVERTERS.

the rotaries and the remainder for the feeders of the Edison three-wire distributing system.

Each direct-current rotary panel controls the current from a pair of rotaries operating together on the three-wire system.

The Edison feeder panels are provided with single-pole four-way switches of special design which permit the throwing of any feeder on any one of four sets of bus-bars. Three of the bus-bars may be supplied at different potentials from each of the three pairs of rotaries. The fourth set of bus-bars is designed for use in connection with the storage battery, when same shall be installed. It will thus be seen that great flexibility in distributing potential is attainable, for, if necessary, the battery can be used independently of the rotaries, making a fourth and independent voltage available for feeder service. The illustrated diagram of the direct-current switchboard shows the instruments and their arrangement sufficiently clearly to render their enumeration unnecessary.

The static transformers and rotary converters were furnished by the General Electric Company. The General Incandescent Arc Light Company furnished the high-tension switches and both switchboards, the latter being equipped with indicating instruments mainly manufactured by the Wagner Electric Manufacturing Company.

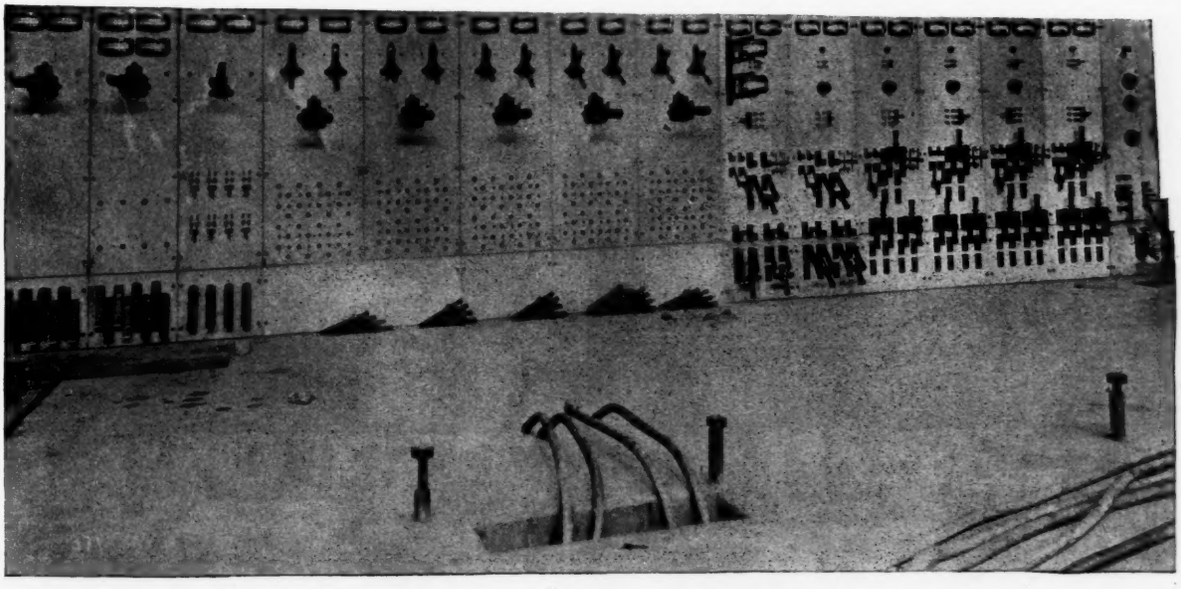


FIG. 12.—SWITCHBOARD, CEDAR STREET EDISON STATION

voltmeters hinged on the right of the board. The other two voltmeter switches in conjunction with the swinging alternating-current voltmeters shown on the left of the alternating-current rotary

The direct-current three-wire switchboard, about 18 feet long and eight feet high (Fig. 3), is at right angles to the board just described. It consists of eight panels, three for the direct-current end of

TESTS.

A report of the tests of the hydraulic and electrical apparatus might prove commonplace, but the following relating to the overhead transmission line and

underground cables may be of interest because little data has been published with regard to the charging current of overhead lines and nothing whatever, as far as the writer is aware, regarding high-tension cables.

The first tests made were simply to ascertain whether the cables could carry the voltage under which they were to operate. The paper cable was first tested, the voltage being gradually raised to 30,400 volts. This was on the afternoon of October 14, which, I believe, marks the date of any attempt to carry such high potential underground. The rubber cable was successfully tested about two weeks later in the same way.

In making measurements and in the following data on the charging current of overhead lines and cables, no allowance is made for any leakage current, as exhaustive and careful tests made on high-tension lines at Telluride by Mr. R. D. Mershon prove that with proper insulators there is no precipitation, and with the voltages here used any leakage current is inappreciable.

The charging current was measured by placing in the high-potential circuit a Stanley hot-wire ammeter reading from zero to 13 amperes. The Stanley meter was compared with a Weston portable ammeter reading from zero to 15 amperes, which had just been calibrated at the Weston laboratory. The difference in readings between the two ammeters was small, but corrected readings are given in the accompanying curves. The voltage readings were taken by a newly calibrated Weston portable voltmeter connected to the secondary of a small transformer, having a ratio of 1 to 200 and designed and built especially for voltmeter measurements by the Pittsburgh Transformer Company. The voltmeter used was compared during the tests with another portable Weston voltmeter with which it agreed closely. It was also compared with a General Electric switchboard voltmeter and the practical correctness of the instrument used was verified.

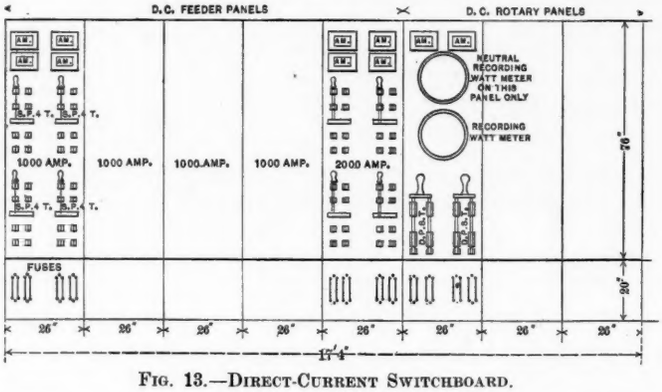


FIG. 13.—DIRECT-CURRENT SWITCHBOARD.

The alternations of the generators supplying current for the charging tests were kept constant by maintaining the speed constant as shown by a tachometer. No measurements were made as to the wave forms of the generators.

In making all charging current measurements, only two generators were used. For supplying the current at the generat-

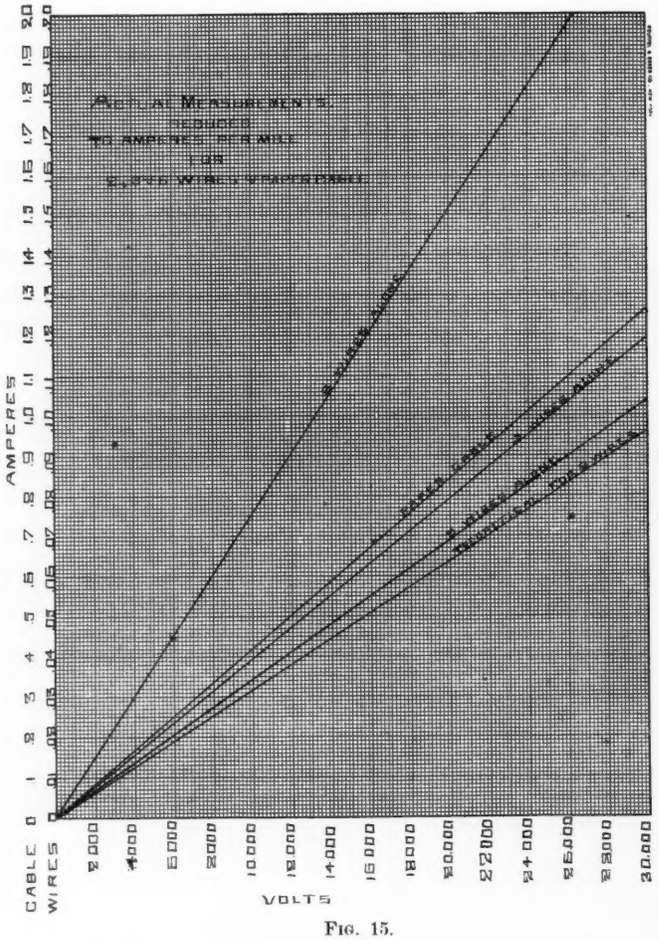


FIG. 15.

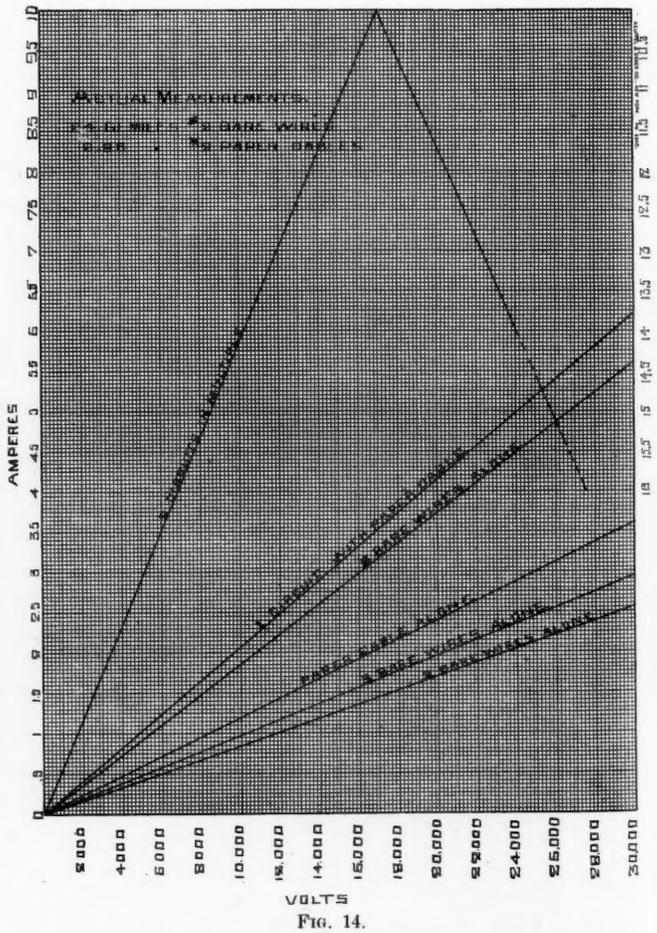


FIG. 14.

ing station, where most of the tests were made, one of the 300-revolution General Electric generators there installed was employed, which by reason of the source of its power could easily be kept at a uniform speed. At St. Paul, a Westinghouse revolving armature 400-revolution 375-kilowatt 60-cycle machine was used.

Fig. 14 gives the curves as plotted from the actual measurements of the charging current to one of the three-conductor overhead lines, also to two of the three conductors, also to the three-conductor line connected to the paper cable, also two three-conductor overhead lines connected one to the paper cable and the other to the rubber cable, both circuits being in multiple with one another, and supplied with three-phase current. The four above measurements were made from the generating station. There is also shown a curve for the paper cable as measured from the St. Paul end by the Westinghouse generator.

Measurements on both overhead lines showed that the charging current to either line was practically the same as that to the other. Furthermore, it was found that the charging current to one line was practically the same whether both ends of the other line were left disconnected from everything, or whether its three conductors were tied together and connected to good ground.

Fig. 15 shows the charging current as measured, reduced to amperes per mile for two, three and six wires (the latter being two three-phase circuits in multiple) and also for the paper cable. From some few measurements the charging current for the rubber cable was found to be a little more than double that of the paper cable. This result from the standpoint of overcoming the reactance in the circuit, would make the use of a rubber cable the most desirable. It will be noticed that the charging current for two wires of the three-phase circuit is appreciably less than when voltage is applied to all three conductors. It checks very closely with what would be expected as figured. There is also shown a dotted line indicating the charging current as plotted from the formula for capacity between two wires. Lack of agreement between the theoretical and measured curves is no doubt mainly due to the departure of the generator wave from that of a true sine curve.

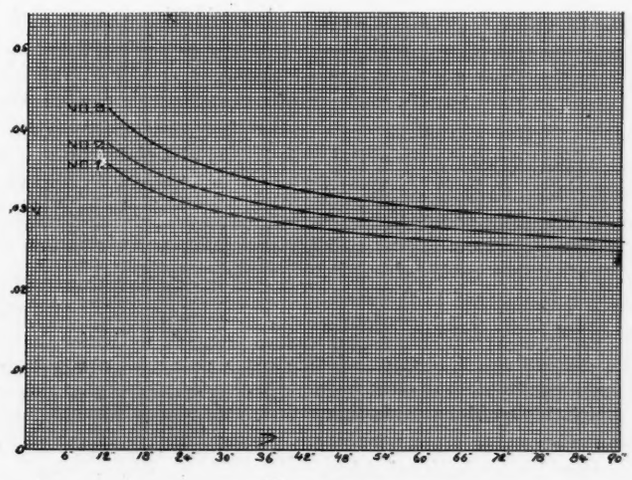


FIG. 16.—VARIATIONS IN CHARGING CURRENT DUE TO SEPARATION OF WIRES.
No. 1 No. 4 Wire.
No. 2 No. 1 "
No. 3 No. 0000 "
10,000 Volts.

Fig. 16 shows the charging current per mile per pair of wires at 10,000 volts, 60 cycles, for Nos. 4, 1 and 0000 conductors with the wires separated from 12 to 84 inches.

These curves were drawn in determining the advisable distance at which to space the conductors, and are here given as illustrating the comparatively small advantage to be gained in the way of reducing the charging current by separating the conductors, after a distance of about three and a half or four feet between wires is reached.

The following data on charging current taken from the writer's note book may be convenient for reference, and is, therefore, here included because it has never before been published.

CALCULATED CHARGING CURRENT.

Two parallel wires: Length one mile: 10,000 volts: Sine wave: Sixty cycles:

The current varies directly as the length of the line, the voltage and the cycles, so that the current for any given line and different voltage or cycles may be easily calculated:

Distance between centres of wires.	Size of Wire—B. & S. Gauge.									
	6	5	4	3	2	1	0	2/0	3/0	4/0
	Amperes at 60 cycles.									
18"	.0313	.0317	.0324	.0332	.0339	.0351	.0358	.0366	.0373	.0386
24"	.0295	.0302	.0308	.0315	.0322	.033	.0337	.0344	.0354	.0362
30"	.0285	.0290	.0297	.0302	.0308	.0316	.0323	.0330	.0338	.0346
36"	.0276	.0281	.0287	.0293	.0299	.0305	.0312	.0319	.0326	.0333
42"	.0269	.0274	.028	.0285	.0291	.0296	.0303	.031	.0316	.0324
60"	.0255	.0260	.0264	.0269	.0274	.0280	.0285	.0291	.0298	.0303

It is a pleasure to state that we have never had any trouble with resonance, harmonics or any other of those "bogies" which have proved in some instances destructive to apparatus and are a cause of disquietude to the engineer of almost any long-distance transmission plant, until after the same has been put into successful operation.

This paper would be incomplete without acknowledging the credit due to the writer's associate, Professor R. C. Carpenter, of Cornell University, for his assistance and cooperation in designing the mechanical and hydraulic plant. Much praise should also be given Mr. L. W. Rundlett, our resident inspector and engineer on the mechanical and hydraulic work, through whose experience, patience and faithfulness, the results of the excellent concrete work were attained. Mention must also be made of Mr. J. L. Harper, who acted as our resident inspector on the transmission line and electrical work, and who is now serving as the general superintendent of the operating station at Apple River Falls. Mr. William De la Barre, of Minneapolis, advised with us from his wide experience in hydraulic matters, and Mr. W. A. Gordon, of our own office, has materially assisted in calculations and tabulations. Messrs. H. J.

Gille and Fred R. Cutcheon, superintendent and engineer, respectively, of the electrical department of the St. Paul Gas Light Company, and Mr. H. L. Doherty, president of the Denver Gas and Electric Company, had much to do with the design of the sub-station switchboards. It should be stated that Mr. Doherty was the first engineer to recognize and appreciate the possibilities for the power development in Wisconsin and its transmission into St. Paul, Minnesota.

Determination of Automobile Speed by Photography.

A large number of arrests which have recently been made in Paris for fast and reckless driving of automobiles has called attention to a recently invented method of accurately defining the speed of such vehicles, thus doing away with the guesses hazarded by police officers on occasions where the driver is supposed to be exceeding the speed limit.

Of all the photographic methods proposed, the one suggested by M. Delamare is said to be absolutely automatic and positively accurate. Determining the speed of an object in motion depends upon the measuring of space traversed in a second. If we represent the velocity by V and the distance traversed by E in T seconds, then,

$$V=\frac{E}{T}$$

The apparatus is provided with a shutter and mechanism for producing on the same plate two distinct, successive images, at intervals of a second, the displacement of the image permitting the measurement of the space traversed. Taking the formula for the lenses in accordance with the diagram mentioned, we have,

$$\frac{E}{e}=\frac{P}{p'}=\frac{p-f}{f}$$

where f is the focal length of the lens used; from which

$$E=e\frac{p-f}{f}$$

If the value of E is known, the velocity is easily obtainable, which resolves the problem into measuring E. It has been shown by the inventor that if in operation from the same position two lenses of different focus are used, F and f_1, which give for E the values of e and e; then,

$$E=(f-f_1)\frac{ee_1}{e_1f=ef_1}$$

This formula is independent of the distance at which the operation is made, and it therefore only remains to construct a hand camera whose shutters are coupled and whose lenses have different focal lengths.

The exposure once made and the plate developed, the measurement can be made and the formula applied, thus indicating beyond doubt the velocity of the conveyance photographed. Although an instrument of this sort fulfills the required conditions, it becomes necessary, before making it practical, to overcome several important difficulties, upon which the inventor is now at work. Chief among them is the fact that a fixed focus lens is required, and the photograph must be made upon that portion of the automobile's course, which is absolutely perpendicular to the focus of the lens. It is thought, however, that this defect is only temporary and that it will be comparatively easy to surmount it and thus make the instrument of a very practical and generally useful nature.

Armored Automobile Train for the British Government.

An automobile road locomotive, heavily armored, and several cars have been recently furnished the British Government by a contractor of Leeds, England, as the first of a series which are to be built upon the same principle for the use of the army.

The initial outfit has been tested over ordinary country roads in England and has been found to be eminently satisfactory, being able to mount a 10 per cent grade with three or four heavily loaded cars. A notable feature of the engine is the windlass mounted at the rear end. In case of a grade too steep to permit the engine to drag the big cars up, they are left at the bottom while the engine goes to the top, unwinding a cable behind it, one end of which is attached to the windlass and the other to the forward coupler of the train at the foot of the grade. This easily permits the locomotive to drag cars up grades which it would be impossible to surmount under other circumstances, and involves very little additional delay.

The armor of the cars is of the usual plate type, put on separately and so fastened that it can be removed easily for either inspection or repairs. It is said that it is considered heavy enough to insure safety from penetration by rifle balls and bits of flying shells. The armament of the train consists of a three-pound howitzer or machine gun for each car, but if it is desirable these guns can be removed and the space used for other purposes, such as the transportation of provisions, men, ammunition, etc., at a speed, when fully loaded, of from two to six miles an hour, the transmission gears on the engine permitting three different rates of speed.

To Guard Against Third Rail.

The following letter is from the Brooklyn, N. Y., *Eagle*, recommending red paint and danger signs to prevent accidents by shocking on the third rail.

To the Editor of the Brooklyn Eagle:

Ever since the installation of the third-rail system on the elevated railroad structure, every endeavor has been made to invent some means to obliterate or, at least, reduce the danger caused by the exposed live rail.

Inasmuch as that up to the present time no way seems to have been discovered to entirely remove the danger, although several persons have already been killed by accidentally coming in contact with this rail, it is believed that the only way to minimize the danger is to make the third rail so prominent that even the most ignorant person could have no excuse for not seeing it.

As it stands now, the ordinary person would not be able to distinguish the rail if, on account of a block, as has been the case a number of times, he should foolishly get down to the structure to walk to the nearest station, and therefore I would suggest that the railway company paint the rail a bright red and paint on the side of the track, at intervals of say 100 feet, the word "Danger" in white letters.

I would also suggest that the rail be moved to the far side of the track of all stations, so that there would be no danger of a person's body coming in contact with same if, by accident or otherwise, he should fall from the platform.

Joseph Caccavajo,
Secretary Mechanics and Traders' Exchange.
Brooklyn, December 10, 1900.

Cuban Contracts.

Cuba being under the United States Government's authority is naturally prejudiced in favor of American machinery, but it is interesting to note that the following contracts for the Havana Electric Railway Company's new line and the reconstruction of the old system, which will be completed about March, 1901, have been let to American interests. The Edward P. Allis Company has been given the engines; the General Electric Company, generators and motors; Aultman & Taylor Company, Cahall type boilers; Wheeler Condenser and Engineering Company, condensers; structural work, American Bridge Company; traveling cranes, Pawling & Harnischfeger; cars, the Jackson & Sharp Company, and general supplies to the Morris Electric Company. The entire line is about 38 miles long, and is being constructed, engineered and managed by Americans.

American Cable Laying.

To the Editor of Electrical Review:

While it is perhaps unkind to carp at the patriotic elation so volubly expressed in your editorial of December 5 over the actual laying of an American sea cable, there are several statements in that article calculated to make the judicious grieve and the old cable-hand smile.

The statement in your opening paragraph that the work of laying the Alaskan cable was "probably the hardest that has ever been undertaken by a cable-laying expedition" shows a not too deep acquaintance with the records of previous cable expeditions. As a matter of fact the Alaskan cable should have been the easiest job of the sort ever undertaken, for the simple reason that the whole route is in shallow water. Had the elementary precaution been taken of not trying to run a ship drawing 13½ feet through 13 feet of water the whole cable would probably have been laid from the original vessel as easily as it eventually was from a lighter, and with as little fuss, for example, as was aroused last Summer by a sluggard British concern that laid some 5,000 nautical miles of cable between Germany, the Azores and the United States.

That in spite of the little difficulty in the navigation of the Orizaba, which ended her career in the manner that threatens to become a familiar story with American cable ships, the cable was successfully laid "in almost record time" (what is the record?), speaks volumes for Mr. Porter's energy, and for the hearty assistance of his staff; but if the cable had been left on the wreck, and no attempt made to lay it in spite of the difficulties, that expedition would have been strangely lacking in the spirit that has animated all submarine cable expeditions that I have ever read of, heard of, or taken part in. A submarine cable that has to be laid or repaired takes, I think, a greater hold on the heartstrings of those concerned in the laying or repairing than any other engineering work, not even excepting a bridge. This is due, in part at least, to a cable expedition being entirely on its own resources from start to finish, and to its sole object being the successful bringing to life of the cable. It is probably the spark of life that courses through a working cable that makes cable men regard it almost as something human. On board a cable ship we never used to drink a toast without adding, reverently, "And the Cable."

It is, of course, important to develop in this country "the art of cable building and the far more difficult art of cable laying." But, Mr. Editor, you are not aiding much in that development when you indulge in hot and injudicious boasting instead of in cold and judicious criticism. You say that "while taking much from the experience of our cousins across the water we may still lay claim to a certain boldness of enterprise and swiftness of execution that have not marked their work in the past." It was certainly extraordinary boldness of enterprise to undertake the laying of a cable of the enormous length of 187 miles at a price that presumably was based on a fair profit, and for "swiftness of execution," the running of the ship hard and fast on a reef directly after landing the shore-end can not be beaten. However, joking apart, I do not in the least wish to detract from the credit due to Mr. Brixey and to Mr. Porter in making, shipping and laying the cable in spite of all difficulties, but it seems to me, Mr. Editor, that you miss the moral of the tale most completely. To compare this little bit of a coast cable in shallow water, that could be laid from a lighter over a block, with the "work in the past" of the English cable-laying concerns is like comparing the foot-bridge to the Pennsylvania ferry with the bridge over the Firth of Forth. In the time that the Alaskan cable took to make and lay any of the concerns on the Thames would make and lay a cable clear across the Atlantic, and a six-line paragraph would tell the story.

What it seeems to me you should point out is not the remarkable enterprise and rapidity of American cable builders, but their astonishing disregard of the experience of "our cousins across the water."

They, for example—the cousins—know better nowadays and have known better for some time than to attempt to lay a cable without thoroughly sounding the route beforehand. The wrecks of the Hooker and of the Orizaba go to show that this important point is not yet properly appreciated by American cable expeditions. From the results of both the Philippine and the Alaskan expeditions it looks, too, as if in the organization of cable expeditions a leaf from the experience of the aforesaid cousins might be taken. The wrecking of both ships would look as if there were lack of harmony between those responsible for the cable laying and those responsible for the navigation of the ships.

In short, it looks to me as if American cable men were beginning where the English began 50 years ago, and were bent on learning by hard experience all that the English have learned in the latter half of the closing century. As you rightly say, the laying of the cable is a more difficult art than the building of it and consequently is the branch where experience pays and where the lack of it is likely to involve calamity and loss.

The story of the application from the English engineer, which arrived after the cable was laid, hardly seems a convincing illustration. Probably the gentleman in question relied on the technical journals for news of the work. News of cable operations is seldom published until the work is well under way or finished. But the record of the Alaskan cable does make one think it a pity that the English engineer's application did not arrive in time for it to be accepted, for had a cable engineer of experience been in charge of the work the cable would in all probability have been laid with neatness and despatch from the Orizaba and that good ship would still be afloat.

You will see, Mr. Editor, I draw from the tale of the Alaskan cable a slightly different moral from that which you draw in your enthusiastic editorial. I thoroughly admire Mr. Brixey's enterprise in building a cable many times longer than any he had ever built before, in shipping it on reels across the continent, in stowing it in a ship not equipped for cable-laying, and in guaranteeing to lay it in good condition; and I also admire Mr. Porter's courage in taking charge of a job in which he had no previous experience, and the pluck and energy with which he pulled himself out of the difficult position in which the Orizaba placed him—and herself. What I do not admire, in these days when submarine cable-laying has become an almost exact science, is the disregard of that science in the organization of the expedition and the exaggerated importance you give in your editorial to this shallow-water cable work as compared with the work of English cable concerns that have been occupied during the past 50 years in lacing the globe with cables in all depths of water and under all manner of conditions. If real deep sea cable-laying is to become an American industry surely it is better to face the real facts and conditions than to encourage the too common idea that "enterprise," "boldness" and rule of thumb methods are better than experience, caution and skill.

Herbert Laws Webb.

New York, December 10.

What the Alaskan cable-laying enterprise should have been was not the text of the article that has caused Mr. Webb to grieve judiciously and to smile; it treated of a considerable exploit accomplished in the face of closely threatened disaster. We are sorry for our lack of cable experience here, but, as Mr. Webb's communication shows, there are many to teach us and we hope to learn. Meanwhile, the enterprising American manufacturer laid the cable and it is now at work.—Eds.

NOTES ON LIGHT.

NOTE CXII—X-RAY LIGHT APPARATUS FOR PHYSICIANS IN THE COUNTRY AND OTHERS.*

BY WILLIAM ROLLINS.

The time will come when every physician will use X-light in diagnosis and treatment. At present the number employing it is very limited. One reason is the defective character of most of the apparatus commercially obtainable.

In cities where the street current is available, it is practical to obtain from several firms, coils and static machines to order, which, by suitable changes, can be made useful. What some of these changes are will be mentioned later. For physicians in the country, remote from electricity or water-power, the problem is a difficult one. This problem I have attempted to solve in several ways for Dr. Williams, that he might be able to judge from observation what apparatus to recommend. I am indebted to him for some of the illustrations of this note. They have been taken from his work on X-rays in medicine, which is shortly to be issued by the Macmillan Company. The cheapest arrangement consists of a 12-inch Ritchie coil, with the modifications shown in Figs. 79, 80, 81. The coil is excited from four storage cells, which are kept constantly charged by 24 gravity cells. This apparatus furnishes enough current to light an X-light tube for an hour a day, using 43 watts in the primary and employing the hammer break usually furnished with the coil. Of course great attention must be paid to having the resistance of the tube such that this small amount of energy will be expended with the least waste. The plant requires no care except to renew the gravity cells at the end of from three to six months, according to the amount of time the light is used. The whole apparatus is enclosed in a case about the height and length of an ordinary bookcase, the coil being on top. I used an apparatus of this kind for several weeks to test its value. The construction is shown in Fig. 82. The second form of apparatus is illustrated in Fig 83. It consists of a static machine driven by a one-horse-power gasoline engine, here shown near the influence machine for pictorial reasons, but which should be in a basement with only the belt coming up through the floor. A quart of gasoline will run a medium-sized influence machine for an hour. There are a few details in Fig. 83 which should be mentioned. The portable stretcher first used by Dr. Williams at the Boston City Hospital is most convenient for examining patients. The stretcher can be brought to the bedside, the patient being transferred to the X-light room with but little danger of fatigue. Hanging from the stretcher is a lead screen connected with the earth through a wire attached to a gas or water pipe. This arrangement of Dr. Williams is a modification of the Tesla screen and protects the physician not only from the effects of the ether strain, which I believe cause the painful burns we often see, but also from the X-light which Professor E. Thomson and other distinguished electricians claim is the cause of the burns.

The third form of apparatus consists of the same gasoline engine driving a one-third-horse-power dynamo, the current being used in one or more ways to excite a coil. First way—the dynamo is wound to 110 volts. The current is sent directly

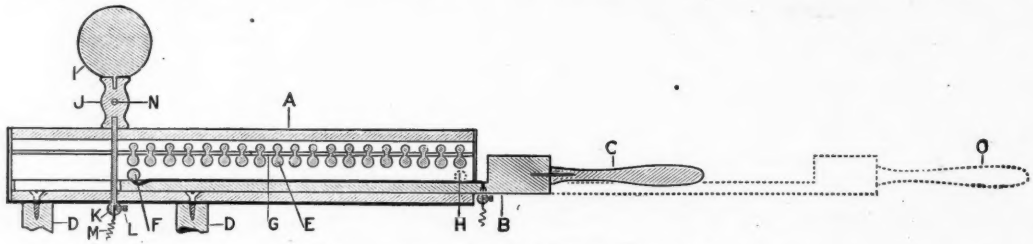


FIG. 79.—SECTION OF MULTIPLE SPARK GAP.

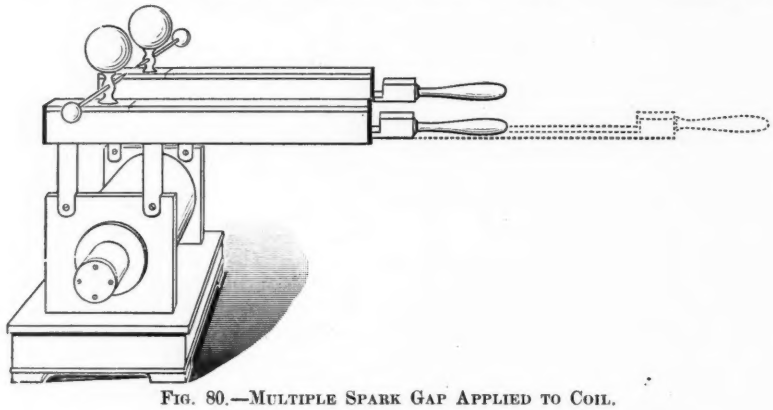


FIG. 80.—MULTIPLE SPARK GAP APPLIED TO COIL.

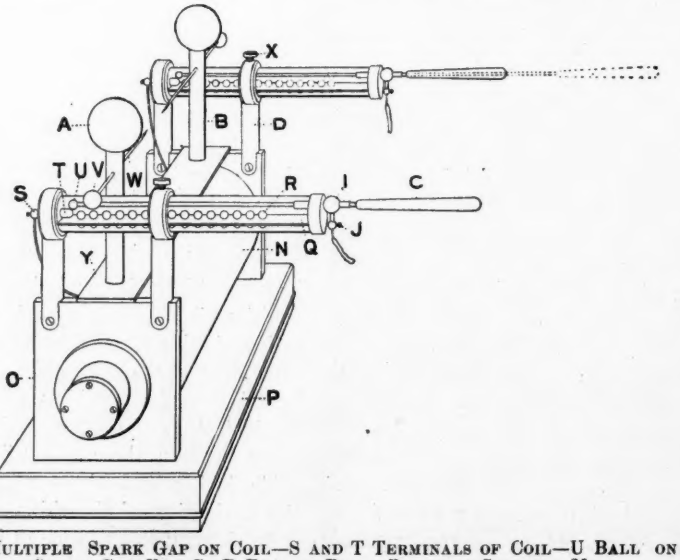


FIG. 81.—MULTIPLE SPARK GAP ON COIL—S AND T TERMINALS OF COIL—U BALL ON END OF SPARK GAP ROD C—R ROW OF BRASS BALLS ON STRIP OF MICA

* Presented at the meeting of the Roentgen Society of the United States, New York, December 13, 1900.

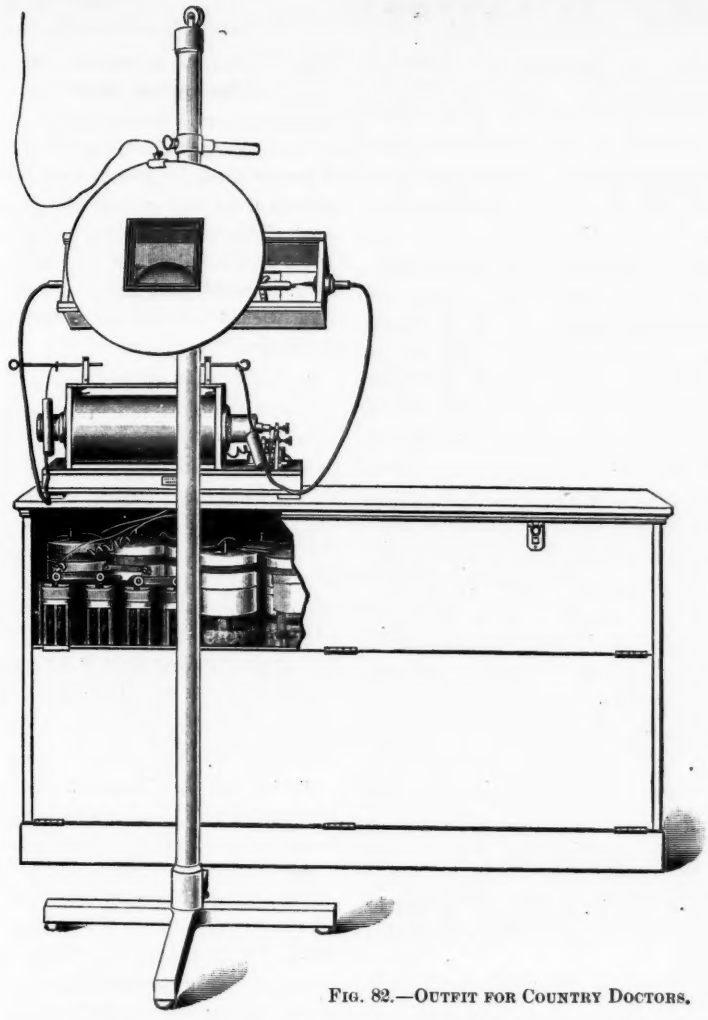


FIG. 82.—OUTFIT FOR COUNTRY DOCTORS.

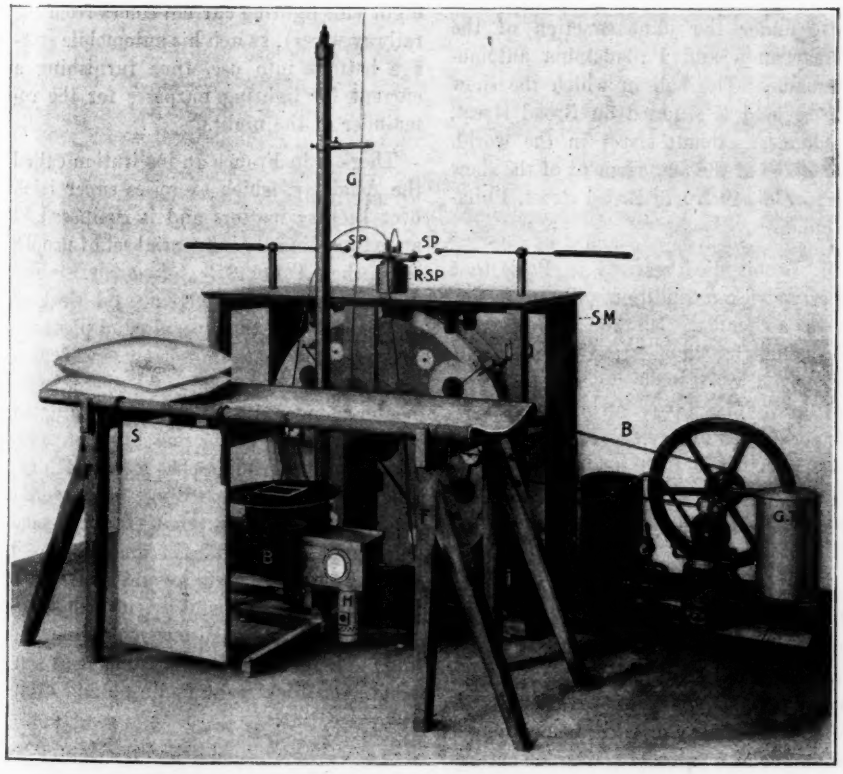


FIG. 83.—STATIC MACHINE DRIVEN BY GASOLINE ENGINE.

into the primary of the coil, being interrupted by a suitable break. This arrangement requires also that the gasoline engine should be run while the patient is being examined. As the engine makes a noise, I have arranged two other ways which do not require the engine to be run at that time. First—the current is used to charge 50 storage cells enclosed in the same case shown in Fig. 82. The charging can be done by a servant at any time. The physician then has the means of exciting a coil for several hours a day without the direct resort to moving machinery. The other way is to wind the dynamo for 10 volts, charging four storage cells with the current, which may be used in the usual primary of a Ritchie coil, wound for that voltage. Any of these forms of apparatus can be assembled by the physician, as the parts are all commercially made.

Whatever form of apparatus is adopted, and wherever it is used, the X-light tube must be in a non-radiable box, from which no X-light can escape, except the smallest cone of rays which will cover the area to be examined. I have given descriptions and figures of such a tube holder in Note xciv, explaining why it must be used. In addition to the reasons already given there is another. X-light tubes burst suddenly without warning, throwing thousands of sharp fragments of glass in every direction. I should have lost my eyesight from this cause if I had not from the beginning used an enclosed tube. No one at present knows the cause of this bursting, which may occur at any time, while the tube is excited or after the current has stopped. It occurs with tubes of different makers; in tubes having hydrogen, oxygen or water vapor regulators, as well as in those without regulators. I showed in Note lxxxvii that while a tube is excited, gas is being driven into the glass, combining with it to some extent. This may weaken the glass.

(To be continued.)

Dielectric Hysteresis.

Some interesting observations on dielectric hysteresis have been lately published by M. F. Beaulard in the *Journal de Physique.* With condensers, of paraffin and mica, little dissipation of energy by hysteresis was found, but with dielectrine, curves of hysteresis of the well known forms were obtained. It was found, however, that the area of the curves and therefore the absorption of energy, varied with the period of time in which the cycle was performed, being less for slow than for rapid cycles. All this, the author considers, is explicable on M. Bouty's hypothesis, according to which the electric residue is due to a temporary retardation of the fictive polarization on the polarizing field. It is to be remarked that M. Pellat has rendered Bouty's explanation independent of the notion of fictive polarization by proving the existence of a real polarization varying with the time, thus explaining the phenomena observed in the present experiments, without assuming the existence of hysteresic properties in dielectrics analogous to those in magnetized bodies.

Automobiles

John M. Ferguson, of Pittsburgh, Pa., United States Consul to Tokyo, Japan, will take his automobile with him when he leaves in the course of a few weeks.

An automobile squadron of 50 vehicles led the Centennial procession of the citizens of Bridgeport, Ct., who celebrated their one hundreth anniversary on November 12.

Rumor has it that the four-cent stamp of the new series to be issued this coming year to commemorate the Pan-American Exposition will have as its central figure an automobile.

Dr. F. L. Sweany, the president of the Pennsylvania Automobile Club, gave the first automobile house reception on record on the evening of November 2 last in his house in Philadelphia.

Notable among the foreign events scheduled for the coming season is the Automobile Week to be held in Nice from March 25 to 29, and the Tour de France, by the Automobile Club de France.

A run was held by the Westchester County Automobile Club on a recent Sunday, the vehicles traveling from the Waldorf-Astoria, in New York city, to White Plains. Some 14 or 15 machines were entered.

Her Imperial Majesty Auguste Victoria, Empress of Germany, is said to be the latest royal chaffeuse, as she appeared on November 3 last in an automobile, which she drove from the Potsdam Palace to visit the Crown Prince.

An Italian gentleman recently made an effective run of two hours and a half in the Alps with a one and three-quarter horse-power automobile, ascending to an altitude of 6,675 feet above sea level, and descending the opposite declivity without difficulty.

Two new showrooms for automobiles have been opened on Fifth avenue, New York, one by the American Bicycle Company at No. 91 Fifth avenue, and the other by the New York Automobile Exchange, which will operate a storage and repair institution at 114 Fifth avenue.

The price of gasoline was recently reduced five francs per hectolitre by the Petroleum Syndicate of Paris; the reason for the cut being the successful carrying out of the Alcohol Criterion race from Paris to Rouen, in which 52 vehicles started and 41 finished, all of them using alcohol.

A California report states that the Automobile Club of California will probably secure a permanent clubhouse in the building formerly occupied by the Mercantile Library in San Francisco. The building is located near Golden Gate Park, where most of the riding in San Francisco is done.

The Automobile Club of New Jersey held a run on election day in which 16 carriages participated. Mr. W. J. Stewart, the vice-president and crack racing man of the club, had not voted when the different members assembled and 10 of them escorted him in their machines to the polling place.

"I have the best authority for stating that the British War Office will shortly be devoting its serious and practical consideration to the use of auto-cars in warfare. The new departure is the direct result of the South African campaign, and recommended by Lord Roberts."—London, England, *Express.*

A £5 cup has been offered by a member of the Automobile Club of Great Britain for the motor vehicle which presents the cleanest appearance on arriving at a certain point after covering a given distance. The scheme is a very practical one, as it should be the aim of the driver to keep his vehicle in as clean a condition as possible.

An automobile show is to be held in Philadelphia February 4 to 9, inclusive, 1901, under the joint sanction of the Pennsylvania and Philadelphia automobile clubs. The hall in which the show will be held is situated on Broad street, the longest asphalt street in the world. The offices of the management of the show are at 138-140 North Broad street, Philadelphia.

M. Lenoir died recently in Paris in a poverty-stricken condition. By profession he was a chemist. In 1860 he was granted a patent for an electrically ignited motor, driven by an explosive mixture of air and gas. The invention was, however, not considered of any value, although two years later his carriage made a number of short trips through Paris streets. He is considered by automobile experts to be the father of the modern industry.

A Boston humorist has found a means of preventing curious individuals from fingering the mechanism of his automobile when he leaves it standing by the curb, says *Automobile Topics,* by attaching to the levers or other metallic furnishings of the vehicle a strong galvanic battery. Upon leaving the vehicle he turns on the current. People do not handle the machine but once.

An old law existed until very recently in the state of Vermont which compelled any road motor vehicle propelled by steam to be preceded by a man who in the day carried a red flag and at night a red lantern. This was practically prohibitive to steam automobiles, but the law has now been repealed and the vehicles may be used without danger of interference by the authorities.

A novel method was adopted by the driver of an automobile delivery van at the exhibition in Chicago recently to illustrate the niceties of its control. A large framework, resembling a seesaw, was built facing the grand stand, the car was driven on to this framework and made to move backward and forward at the balancing point, causing the seesaw to oscillate, after which a box was placed in the centre of the track and the car driven over it with such control that an egg which had been placed on the opposite side was not only not crushed but merely cracked.

An idea of the distribution of news may be found in the following paragraph taken from the Mexican *Herald* of December 5:

An ingenious automobilist of Willoughby, Ohio, who operates an electric vehicle, has rigged up a connection between his stable and his house by means of which he can, immediately the power is turned off at the trolley station for the night (his lighting current comes from the railway wires), switch his automobile storage battery into use, thus furnishing a current for lighting purposes for the remainder of the night.

There is in France an institution called the Academy, which exercises supervision over literary matters and is composed of an extraordinarily influential set of people, says the *Automobile Magazine.* The French language needs a good deal of supervision and these people find pleasure, and probably some amusement, in keeping the language in order. As there is no neuter gender in French everything is compelled to be either masculine or feminine, and the Academy has given forth the following rules regarding new words, among which occur the terms "automobile" and "locomobile." The former is decided to be a masculine and the latter a feminine noun. Just why, no one seems to know, for to make one masculine and the other feminine by *fiat* is about as sensible as calling night feminine and evening masculine.

"A curious occurrence transpired at Weiler-Allenfurth, near Nürnburg, Ger-

many," says a contemporary. "A young dude who was driving an automobile found himself stalled by one of those accidents which seem to be the particular fate of novices, and asked a wheelman to go for a team in order that he might take his machine back to the city, its motor having mulishly refused to operate. The wheelman complied with the other's request and the animal which he sent to do the hauling was a cow with a yoke over her shoulders. The unusual procession of the cow and the automobile was said to have been the delight and amusement of all the villagers while en route to the repair shop."

In commenting upon the high prices of automobiles, an automobile journal states that the cost of building and selling a good machine is considerably more than most people imagine, and adding to this the demand, which is said to be in excess of the supply, there is no reason for a drop in price at the present time. When standard typewriters are considered and their price taken into consideration it may be safely predicted that the change in the selling figures for automobiles will not be materially reduced in the near future. When the typewriter first came out it was predicted that the price could not hold long as competition would bring it down, but the fact that it has been maintained at nearly its original rating seems to give precedent for a corresponding theory regarding automobiles.

Automobiles are not baggage. This would seem to be self-evident, but the Central Passenger Association has found it necessary to so rule in effect in reply to the demand of a popular actress to have her machine checked with her wardrobe, says the *Railway Age*. The demand is only a shade more unreasonable than that of bicycle and tricycle owners, for the free transportation of their machines under the name of baggage. Granted that a bicycle is baggage, then these deductions logically follow: A bicycle is a vehicle for carrying passengers and property; wheelbarrows, baby carriages, automobiles, coaches and farm wagons are vehicles; therefore they are baggage; therefore they must be checked in baggage cars. The fallacy lies in the first premise. The railways have now generally decided that bicycles are not baggage and hence are not to be checked free; yet they continue to carry them in baggage cars for a consideration. But the capacity of baggage cars is limited, and so a line of distinction has to be drawn, with bicycles and baby carriages admitted and automobiles and the rest ruled into the freight or express car.

Views, News and Interviews

Patient—Your own health seems to be very much improved of late, doctor. Doctor—Yes, I sold my horse and carriage, and bought an automobile recently. Patient—Ah! you attribute your improvement to that? Doctor—Yes; the walking has done me good.—*Philadelphia Press.*

Telephone subscribers are sometimes annoyed by the peculiar mental processes of the "centrals." An instance of this recently occurred when a subscriber of a New York company asked to be connected with Dow, Jones & Company. The central's query was: "Does it begin with a capital D?"

The moving sidewalk and the escalator are perfectly familiar but it remained for Paris to install an electric moving platform at one of its railway stations, which lifts baggage, trunks and other personal effects from the train door to the higher street level. The lift, which is about 20 feet, is said to be accomplished by means of an inclined platform.

An electric elevator is soon to be installed in the Washington Monument, at Washington, D. C., to replace the present steam lift. When put in operation it will be the highest running single elevator in the world, ascending to a height of 500 feet. The elevator service of the Eiffel Tower, in Paris, France, which is higher than the monument in Washington, consists of three separately running cars, in which the visitor is taken to the top by stages, and not direct.

The Borough of Bronx, New York city, famed for its goats, wild animals, reptiles and elephants, a camel or two, and the rhinoceros, was the scene of a trolley accident recently, where two laborers were lassoed by the control rope of a trolley car. As the car passed them the pole conductor suddenly broke and allowed the pole to fall across the roof of the car, the rope flying out in a semi-circle and gathering in the two men as neatly as if thrown by an expert lassoer, dragging them about 50 feet before the car could be stopped. When the motorman and conductor came out to the rescue the rope was found to be so tightly entangled about the men's necks that it had to be cut. They were removed to the hospital and will recover.

The *Cape Times*, Cape Town, South Africa, contains the account given below of an ingenious telegrapher's artifice in repairing a dismantled instrument during the late Anglo-Boer War: "When Rouxville was abandoned, the postmaster brought away with him the key of the instrument, etc. The next day, Captain Halse, with some 30 Cape police, went on patrol in that direction, and Mr. Flaxington, a young operator in the Aliwal North branch offered to accompany them. They managed to get into Rouxville, and Flaxington at once made for the telegraph office. The instrument was apparently useless, but he secured the office door key, twisted a piece of stout wire round the middle, stuck the wire in the bridge of the instrument, and soon called up 'Smithfield.' He had just time to send an important message through to the officer commanding at Bloemfontein when the alarm was given that a large body of Boers was in sight, and the small party made tracks for the Orange River, crossing into Herschel, and returning home *via* Lady Grey. The readiness of resource shown by this young telegraphist is worthy of praise."

Perhaps the most curious street car line in the world is one operated in Hendersonville, N. C., by a Mr. Pickens, who owns it, the road in question, running from his house to the depot, a distance of one and a half miles. The following rules are tacked up in a prominent place in the car and have attracted considerable attention:

(1) Passengers are requested not to hang their feet on the benches in front of them.

(2) No drumming is allowed in the car.

(3) Invalids and all helpless persons are required to have a guardian.

(4) Passengers must not squirt tobacco juice on the benches.

(5) No passenger can bring more than one piece of baggage without extra charge.

The rolling stock of the road is included in its entirety by one car of unique construction; it consists of a plank floor and a top which is supported by two side posts. Four wooden benches are placed inside, the two forward ones having their backs to the driver and the two rear ones facing him. Two very small mules draw the car, which meets all incoming and outgoing trains—four in number—and between times it will call for any one living on the car line, waiting any length of time not exceeding an hour. There is only one curve in the track and the driver invariably is compelled to get out and push the car. It is stated that on a recent trip when a very fat woman was the sole passenger she herself was forced to get out until the car was pushed and pulled around the bend.

SOME OF THE REQUISITES OF MODERN LIGHTING GENERATOR SETS.*

BY H. G. REIST.

At the Washington meeting of the American Society of Mechanical Engineers, May, 1899, an interesting and stirring paper was read by Mr. Stanwood on "Standards for Direct-Connected Generator Sets." So far as I know, this was the first time that the desirability of engine and dynamo builders getting together and trying to make their designs interchangeable as far as practicable, was brought before the public. Its importance was at once realized and action taken toward improving matters by the appointment of a committee and by inviting other organizations interested to cooperate. I understand these committees are taking up the standardization of speeds of engines as well as the proportion of certain parts that effect the two pieces of machinery, such as the dimensions of base and the diameters of the engine shafts.

It will not be possible to fix absolute speeds for engines used for directly driving alternating-current machines, because currents of various frequencies are used for different classes of work, and dynamos must be built with an even number of poles or, better yet, with a number of poles that is divisible by four. The ordinary frequencies used are 25, 40 and 60 cycles per second in this country, but in Europe the usual frequency is 50 cycles. To illustrate the variation in speed necessary for the various frequencies: for 60 and 40 cycles, a speed of 200 revolutions per minute may be used, but for 25 cycles the speed should be 187 or 214. Similarly we can make 60 and 40-cycle dynamos to operate at 100 revolutions per minute, but the 25-cycle machines must be driven at 94 or at 107. In working over a list of speeds for the various frequencies it will be found that a mean speed may be selected which in no case need be much departed from, so that it seems perfectly practicable to select a range of speeds for the various sizes of engines at which they may be run without any changes except an adjustment of the governor. Then by a careful selection of sizes, best ranged in geometric progression, it will be feasible to keep down the number of machines very greatly, leading to duplication, thus to the practicability of making special tools for more of the parts and also to carrying parts in stock and helping toward quick deliveries.

We have given considerable thought to the selection of a range of sizes and have come to the conclusion that if the units were so spaced that each one has a 50 per cent increase over the one below it, there will be a sufficiently large number of machines to meet all ordinary conditions. This conclusion was also sustained by having had practical application in lines of generators and motors spaced about in this way, so that it is rare that it becomes necessary to go to the expense of developing anything between. This method of determining sizes necessarily gives some of the machines on the list odd ratings, but this will occur in any case many times with either the engine or the generator, since one is rated in horsepower and the other in kilowatts. A table is submitted herewith giving sizes of generators and speeds that are proposed.

The variation in speed given in the tables allows the same engine to drive generators for the three frequencies standard in this country. It will be noted that with very few exceptions the total variation in speed is less than 10 per cent, in most cases being not more than two and a half per cent for the mean speed. For each capacity given, except the smaller ones, several speeds are proposed to accommodate the different types of engine.

In all reciprocating engines there is an intermittent speed, the speed gradually increasing during the stroke until such time that the power applied is less than the mean power absorbed, after which the speed gradually decreases until steam is again admitted. It will thus be seen that in every single-crank engine there is during each stroke or each half revolution a period of increasing speed and one of decreasing. With two cranks at 90 degrees there will be four such periods during each half turn. With cranks set 120 degrees apart there will, of course, be six such periods. The amount of fluctuation in speed is dependent on the number of cranks, the weight of the reciprocating parts, the length of the connecting rod, the proportion and adjustment of the valves and the weight of the flywheels. It is desirable to keep this variation within certain limits on account of the parallel operation of the generators, but more particularly to insure the satisfactory operation of synchronous apparatus, such as synchronous motors and rotary converters from such circuits.

When two generators are running in multiple, their mean speed will be the same, but as the speed is variable, as already explained, there is an instant during which one generator runs a little faster than the other. It will be seen that its potential wave will then get ahead of the wave produced by the other machine and in consequence current will flow into the second machine and tend to drive it as a motor. A little later, when the engines are further along in the revolution, these conditions will be reversed. This produces cross currents between the machines which should be avoided. It might be prevented with duplicate sets, if the engines were synchronized, that is, if they were run with the cranks of the machines in the same relative position. The angle of velocity of one engine is then the same as that of the other at all times. But this is not a practical method of operation. This fluctuation is also liable to make synchronously driven electrical machinery drop out of step. In practice, the allowable variation is usually given in displacement in degrees of any point on the rotating mass from what it would have if the motion was perfectly uniform, which gives a value that is independent of the number of cranks of the engine. Steam engines intended for directly-connecting dynamos should not have an angular deviation in degrees of more than two and one-half or three degrees of phase; or, dividing the number of one-half of the number of poles of the generator to be driven, will give the allowable angular deviation in terms of degrees of the rotating mass. Thus, a 40-cycle machine should be driven by an engine whose motion is so uniform that a point on the rotating mass will not vary more than $\frac{2.5}{20}$ or $\frac{1}{8}$ of one degree from the position it would have if the motion was perfectly uniform.

In order to obtain this result it is necessary to proportion the flywheel, the weight of which depends upon many things, relative to the proportion of the engine, and can not be given except in special cases. It is specially desirable in designing the engine to proportion the flywheel, with this in view. The proportion of the connecting rod is also a matter of importance in this connection.

Mr. Reist here submitted data covering the flywheel effect necessary to meet the above degree of regulation and submitted a formula representing a safe figure for well proportioned engines. Mr. Reist's formula covered 25-cycle, 40-cycle and 60-cycle machines and was varied to apply to horizontal engines as well as vertical, to single-cylinder engines as well as compounds. It would naturally be expected that a three-crank engine, with cranks placed at 120 degrees apart, would require a lighter flywheel than one with two 90-degree cranks, but in working out the forces of compound three-cylinder en-

* Abstract of a paper read before the Engine Builders' Association of the United States.

gines, it is found that other conditions so far enter into the problem that no appreciable better result is obtained than from a two-crank cross-compound engine.

Ever since alternating-current machines have been built parallel operation has been discussed and tried, at first with great caution, but it is at present the usual method of operation of installations, and experience has taught us that any two alternators of the same frequency and potentials will operate in multiple satisfactorily, if they are allowed to do so by the prime motors. No trouble is experienced in operating machines in multiple when driven by water-wheels. There are also many installations of steam-driven alternators, ofttimes of different types, both belted and direct connected, operating satisfactorily in multiple. The principal trouble experienced in the parallel operation of alternators is due to the variation of the speeds of the machines with reference to each other, producing oscillations in the relative motions of the two alternators. This produces cross currents in the variations of the cutoffs of the engines.

In some cases the amplitude of these oscillations is limited in extent, while in others the force is liable to accelerate with more or less rapidity until the machines drop out of step. In some cases the machines may run in parallel for a considerable period, then by some change of conditions oscillations will begin, throwing the machines out of step in a few seconds. The power to produce these oscillations comes naturally from the steam and is caused by the intermittent action of the engine governors, which in their efforts to adjust themselves to compensate for the speed variation cause a periodic delivery of steam. This delivery of steam by jerks keeps up the oscillation in the same manner as the pendulum of a clock. The frequency of this variation is affected by many conditions aside from the flywheel effect of the rotating mass on the engines, the period of the engine impulses, the synchronizing power of the dynamo, and probably the flywheel effect of any synchronous machinery driven by the current from the dynamo.

The degree of retardation of the governor required by proper parallel operation must depend upon the combination of these effects and is consequently difficult to predetermine. Mr. Reist submitted one or two illustrations covering this point and the manner in which the difficulty had been satisfactorily overcome.

There are, however, cases where a simple retarding device is not sufficient without seriously affecting the governing of the engine. A special device was suggested to cover a case of this kind. Engines that are directly coupled to alternators that are to be run in parallel should be provided with means by which the speed may be adjusted within a small range without throttling while the engine is running. Such a device is very useful in bringing the machines together without throwing them into parallel when one machine is loaded and the other is idle, otherwise it is necessary to throttle the steam for the engine without load to bring it to the speed of the loaded machine. This device is also very useful to divide the load between the machines, since, however carefully adjusted, high temperatures or some other local condition may throw them slightly out of adjustment.

Electric Pumps for Havana's New Sewerage System.

A new sewerage system for the city of Havana, Cuba, contemplates the use of considerable electrical machinery as a part of the equipment. While detailed plans and specifications for the electrical machinery required have not as yet been prepared, the ELECTRICAL REVIEW has been able to secure the following information in regard to the proposed scheme.

The sewage of the entire city is to be collected on the west side of the harbor, thence carried across the harbor in a siphon, raised at the main pumping station 24 feet and discharged through an outfall tunnel and sewer 1,190 metres long, and thence into the sea in 30 feet of water through two five-foot pipes. At the discharge well on the west side of the harbor, where the sewage is first collected, a centrifugal pump with a capacity of 30,000,000 gallons per day, 11-foot lift, direct-coupled to an electric motor, will be installed for temporary use, while the siphon and permanent station are being built for emergency use thereafter. It is proposed to purchase the current required to drive this pump.

In Vedado, a suburb of Havana, two sub-stations, which will be of underground masonry construction, will be built. One of these will contain two sub-lifts, each consisting of a motor and direct-coupled centrifugal pump with a capacity of 2,500,000 gallons of sewage per day for a lift of nine feet, and the other will contain two sub-lifts, each with a capacity of 800,000 gallons per day, the lift being 10½ feet. Both sub-stations will be arranged to work automatically. These stations are both to be supplied from two direct-coupled electric generating outfits of 12 kilowatts capacity installed in the main Vedado pumping station.

Massachusetts Institute of Technology.

A base measuring apparatus which has been perfected in connection with the Summer school work of the civil engineering department of the Massachusetts Institute of Technology, for a few years has recently been tested by the Coast and Geodetic Survey in Washington. Such satisfactory results have been already obtained and others assured that the apparatus is about to be used in the important Lampasas Base in Texas.

Professor Burton, of the Institute, under whose directions the apparatus has been worked out, has been invited to accompany the expedition which is to make a careful trial of the method in the field and upon extended exact work.

The apparatus represents the final results of thesis investigations by several graduates of the course in civil engineering who have worked upon it in successive years. One part of the apparatus maintains a constant tension in the steel tape while in use. Another part of the apparatus determines very accurately the mean temperature of the tape by measuring its electrical resistance by means of a special form of thermophone devised by two graduates. The complete apparatus is not bulky and is of high value for exact measurements.

Power-House Explosion in Chicago.

Five men were killed and 17 people were badly injured by the explosion of a boiler in the power-house of the Northwestern Railway Company, at Kinzie and Kingsbury streets, Chicago, Ill., on December 3. The 10-ton boiler, which was one of a battery of four in the plant, was hurled through the south wall and crashed through a parlor car in an outgoing passenger train outside. The damage done to the power-house was about $45,000 and the traffic of the road was seriously delayed.

The plant furnished, besides its traction power, energy for the lighting of the entire neighborhood, which was instantly plunged into darkness. Thousands of people who were waiting to take the trains to get home, as the time when the accident occurred was at five o'clock in the afternoon, the busiest part of the day, were delayed for hours and finally compelled to take the surface cars, as the cutting off of the power interfered with the working of the semaphores and switches, so that every switch from the depot as far as Deering and Fortieth streets had to be worked by hand for three hours after the disaster.

Electric Lighting

A new electric lighting company is being agitated in Johnstown, N. Y.

A new electric light plant will be erected in Zionsville, Ind., at a cost of $6,000.

Another municipal electric light plant is soon to be added to the already large Canadian list. This time it will be in Kingston, Ont.

Parrsboro, N. S., is to have a municipal lighting plant of 500-light capacity. The new plant will be in operation about January 1 of next year.

A permit was recently secured by the Light, Heat and Power Company, of New Albany, Ind., to erect an addition to its plant at a cost of $1,500.

An electric lighting plant is soon to be installed in Bancroft, Ont. It will have a capacity of 500 lights and current will be turned on about Christmas time.

Plans and specifications have been prepared and the Richmond, Ind., city council has accepted them for the proposed municipal electric light plant. Tenders will be advertised and the contract let in January of next year.

To stockholders of record on November 21, $520,000 worth of authorized stock will be issued by the Kings County Electric Light and Power Company, of Brooklyn, N. Y., to bring its capital to the chartered limit of $2,500,000.

An instance of Canadian enterprise may be noted in the fact that a Colborne, Ont., manager whose electric lighting plant was destroyed by fire some time ago, succeeded in getting his plant in running order within three weeks after the fire.

An increase to the capacity of the Bridgewater, N. S., electric lighting plant has been found necessary as the demands upon its incandescent service have greatly increased. One new 80-kilowatt generator, with switchboard, etc., will be installed.

Hydraulic power has been secured for the operation of the Marmora, Ont., Electric Light Company, which is installing a 1,000-light alternating-current generator. The company expects to be in operation before the extreme cold weather sets in.

The Shenango Valley electric light plant and the Sharpsburg Electric Light Works, of Pennsylvania, have been purchased by representatives of the New York Trust Company, who will organize a corporation to build an electric railroad, for which over $2,000,000 will be invested in the towns named.

A report from Kalamazoo, Mich., states that a government surveyor, who has been making observations of the deflection of the magnetic needle from a point in Bronson Park marked by the government in 1874, was compelled to move his observation point a mile to the eastward as electric railway lines, about a block away on either side had a powerful influence on the deflections.

If the proposition for a municipal lighting plant, soon to be voted upon by the city of Brighton, Iowa, is carried, the power will be obtained from a plant operated by a water-mill on the Skunk River about two miles away, where abundance of energy can be obtained at a very small cost. Winfield, a neighboring town, recently put in a similar plant, and it is now said to be in successful operation.

The contract for lighting the streets of Montreal, Canada, which is in force at present, expires on December 1, 1903, and tenders are soon to be invited from firms desiring to take up the contract, the matter having been agitated at the present time in order to allow the successful bidder time enough to install the necessary plant. It is believed that to do this will require about two years.

One of the largest generators in Canada has just beeen installed by the Cataract Power Company, at Decew Falls, Ont., for light and power purposes. It is believed to be the largest in North America, having a capacity of 2,000 kilowatts normal, and ability to take care of a heavy overload, weighing complete 220,000 pounds or about 110 tons. This addition to the company's plant makes its complete energy over 10,000 horse-power.

Four years ago Newmarket, Ont., undertook to run a municipal electric light plant for street as well as commercial lighting, and installed a plant which was then capable of taking care of all the requirements of the town. Now, however, it is inadequate and is to be increased by an additional 100-kilowatt, two-phase dynamo with the necessary accessories. When the installation is finished the plant will be one of the most modern in all Canada.

Minneapolis, Minn., is disturbed over the question of street lighting, $147,000 having been appropriated for the electric and gas lamps for this year. Less than $80,000 is appropriated in Kansas City for the same purpose, and the Minneapolis papers are devoting considerable space to the matter. Kansas City's lighting system is said to be a reproach to the city, as the parks and boulevards are not lighted at all, and the Minneapolis journalist goes on to state that the famous remark of Mayor Ziegenheim, of St. Louis, is applicable to Kansas City. A committee of the citizens called upon him and made a vigorous kick on the absence of street lights in St. Louis, the Mayor replying, "Vell, we haf the moon already, ain't it?"

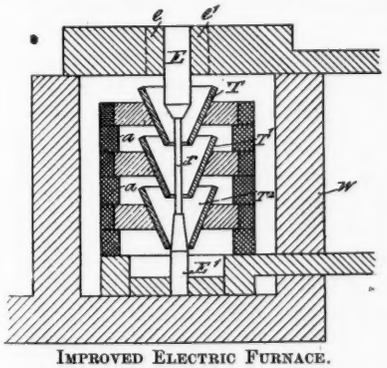
Two lighting bills were recently introduced into the Philadelphia city council regarding the lighting of the city. In exchange for certain privileges the Kensington Electric Light Company asks the right to construct and maintain or lease conduits, manholes, electric conductors, and make house connections for light, heat and power within certain portions of the city defined in the ordinance. All privileges asked for are subject to the condition that between January 1, 1915, and January 1, 1916, the city may purchase all franchises and property of the company. If the privileges are granted the company will pay annually to the city treasury a sum equal to about one per cent of its gross receipts. Another measure before the common council was that introducing an ordinance to appropriate $40,000 for the construction of a plant to supply electric lights for Fairmount Park.

A new law was passed last Spring to effect the conviction and punishment of the thieves of electricity. As was noted in the ELECTRICAL REVIEW in a previous number some Chinamen in New York were arrested for having doctored their electric light meters so as to obtain light without paying for it. They were, however, discharged as the judge held a simple Chinaman could not have worked such an ingenious scheme, believing that an electrical expert was at the bottom of the conspiracy. Other offenders, however, have not escaped so easily, and an amendment has been passed to Section 651 of the penal code regarding particularly those persons who wilfully or with intent to injure or defraud or in any way interfere with the rightful revenues of electric, gas or any other lighting company. The electric companies knew perfectly well some time ago that they were being systematically robbed, but even though they caught the offender there was no law, up to April 23 last, which, if enforced, would act as a deterrent to other would-be thieves. It is believed that the new law will have a salutary effect.

Recent Electrical Patents

A new insulating composition, invented by a resident of Vienna, Austria-Hungary, named Carl Jung, consists in a vulcanizable mixture of caoutchouc and casein. The method of preparing the composition consists in taking washed crude caoutchouc, adding thereto an amount of finely pulverized casein, and then mixing the two ingredients thoroughly and intimately by means of the kneading or mixing machine, used in manufacturing rubber, until the whole forms a homogeneous mass. In order to vulcanize the mixture, a certain amount of sulphur is added, and the whole is then submitted to the vulcanizing operation. The result is a substance having the appearance and physical properties of ordinary india-rubber, and not inferior in quality thereto. Whether a hard or soft rubber-like product is obtained, depends on the amount of sulphur or other ingredients added, as in the ordinary art of manufacturing rubber.

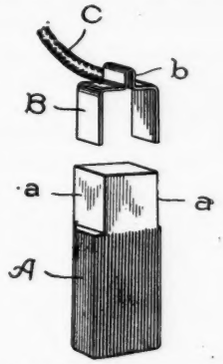
Another German, of Nuremberg, named Hugo Koller, has devised an improved electric smelting furnace which consists more particularly in the arrangement and



IMPROVED ELECTRIC FURNACE.

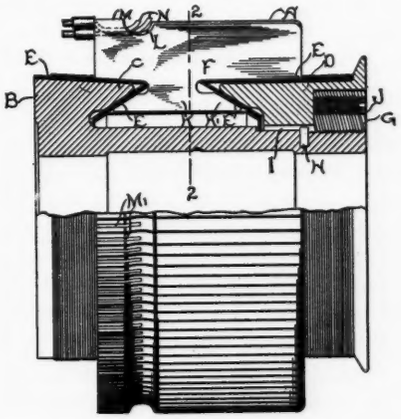
construction of the electrodes. He provides a pair of vertically disposed current-feed electrodes. Surrounding these current-feed electrodes are a plurality of vertical superposed disconnected hopper-shaped electrodes, which are arranged between the feed electrodes and are insulated from them and from each other.

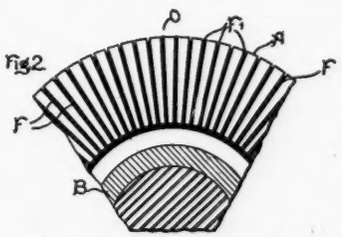
In order to provide an efficient contact between the conductor and the carbon brushes of dynamo-electric machines or motors, Mr. Albert L. Rohrer, of Schenectady, N. Y., has devised means which not only furnish a contact of large area, but which takes up a comparatively small amount of room. In carrying out his idea, he first coats the upper end of the brush with hard solder, and provides a clip which is connected to the conductor and has a pair of spring arms adapted to embrace the soldered end of the brush, which end is cut away so that when the arms are in place their outer faces will be flush with the face of the brush. After



CARBON BRUSH CONNECTOR.

placing the clip upon the brush, the entire device is heated so that the solder will fasten the clip. The joints are afterwards electroplated with copper or other good conductive material. A broad and comprehensive patent has been secured on this connection, and is now controlled by the General Electric Company.





AN IMPROVED COMMUTATOR.

What is an exceeding simple and apparently important improvement in commutators has recently been invented by Edward D. Priest and George L. Schermerhorn, of Schenectady, N. Y. In the modern commutators, the copper sections are insulated from each other by means of mica strips. These mica pieces, however, are much harder than the copper, and therefore the copper segments wear down faster than the mica. The result is that after a certain time, the mica strips project slightly, perhaps only from one-half to three one-hundredths of an inch above the general surface of the commutator. It will be obvious that when this occurs, the brushes will jump more or less each time they strike one of these projecting mica strips, and there will, therefore, necessarily exist a powerful arc. The present invention is aimed to overcome this difficulty, and is accomplished in a very simple manner. It consists in making the mica pieces shorter than the copper segments, so that they will lie below the plane of the copper segments, which can, therefore, wear down materially before the mica strips will be exposed. The invention has been assigned to the General Electric Company.

The Capital Value of Waterfalls.

In a recent issue, the London *Electrical Engineer* takes issue with us. It says:

"The continent of North America is wonderfully favored in respect to the water-power which it has available in connection with what is the largest system of fresh-water lakes and rivers in the world. As our contemporary, the ELECTRICAL REVIEW, of New York, justly points out in an editorial article, the value of large waterways has been realized from the first settlement in the country, and the connections between the great chain of inland seas and the ocean has been greatly improved. A new phase of the value of this large water system is now beginning to be developed, and our contemporary points out that no less than 400,000 horse-power of plant is being laid down at the present time or is in actual work. Still, this horse-power represents but a very small percentage of what could be obtained, but the capital cost of the same is by no means insignificant. Our contemporary estimates the income from the above-mentioned horse-power at £1,600,000 per annum. The capital value of an income of this kind is, of course, very much larger, but our contemporary is quite wrong in putting it so high as £500,000,000, as at this figure the income is not one per cent. However, even with another cipher struck off the capital sum, one can not but realize what a large value the waterfalls are to the country in which they are situated."

Our contemporary errs in quoting our figures, which were $2,000,000,000, or £400,000,000. By an error of the types, our figure was too large by a cipher. Eight million dollars a year is four per cent interest on $200,000,000. Surely, though, even this sum is sufficiently great to command admiration when it is recalled that it has been added to the wealth of the United States and Canada in less than a decade by a single development of electrical engineering.

Telephone and Telegraph

The Mezomanie, Wis., Telephone Company has recently been organized by local interests to construct a telephone line to Dodgeville.

The Richmond, Ky., Telephone Company has passed into the hands of the Cumberland Telephone Company, of Louisville, and the latter will take charge of the Richmond company's plant about December 1.

Work on the Fox River Valley telephone system has been begun between Medina and Kaukauna, Wis., and it is expected that the line will be completed and in operation by January 1, connecting with the Little Wolf system.

Poughkeepsie, N. Y., has granted permission to the New Telephone Company to lay conduits on Main street, from Washington to Clinton, provided the excavations made each day are filled in again at night, thereby leaving no portion of the street open between 6 P. M. and 7 A. M.

The capital stock of the New Brunswick, Canada, Telephone Company has been increased from $150,000 to $250,000 and its new line from Fredericton to Chatham and the Miramichi district is in operation. Wires have already been strung and instruments placed at Stanley, Boiestown and Doaktown.

The tender of the Telegraph Construction and Maintenance Company for laying a cable from Vancouver, B. C., to Queensland and New Zealand by way of Fanning Island, Fiji Islands and Norfolk Island, for £1,795,000 has been accepted by the parliament. One of the conditions of the acceptance is that the line is to be finished by December 31, 1902.

The franchise, lines and rights of the Deer Island Telephone Company, of Deer Island, Me., have passed into the hands of the New England Telephone and Telegraph Company by purchase and the new owner will take possession on January 1. A line will be laid by cable across Eggemoggin Beach, two miles, to connect Deer Island with the New England company's system.

Permission has been granted in Wilmington, Del., by the Levy Court, to the New York, Philadelphia & Norfolk Telegraph Company to erect poles on the causeway south of Appoquinimink hundred leading to Odessa. The permission was granted on condition that the poles should reach a height of 35 feet. It is said that the Postal Telegraph Company will work in connection with the other corporation.

A movement is on foot in Vernon, N. Y., to have a telephone line built from that town to Knoxboro, and also from Vernon to Kenwood. It is stated that the expense will not be very heavy as the farmers who are interested along those lines and wish telephones in their houses can furnish poles instead of paying for all their stock in money. When completed the lines will be run into the office of the Rome Home Telephone Company.

An ordinance recently passed by the board of public works of Louisville, Ky., provides for a bid of not less than $10,000 for a telephone franchise for the city, and tenders will soon be advertised for by the general council. The matter would already have been advertised, had it not been that there was some question regarding the validity of a previous franchise and the board waited for a decision on the question by the judiciary.

The metallic system now in use by the Mexican Telephone Company is stated to be the cause of that system's increased earnings. The cost of the metallic system is $125 a year, while the old system of open-wire instruments was $75. A large number of subscribers is said to be substituting the new for the old, and the company is refusing to accept any new subscribers for the old system. The total number of subscribers on December 31 was 3,361, a gain of 406 over a year ago and 296 since March 1.

A London press despatch states that Signor Marconi is planning to erect wireless telegraph stations along the route from Great Britain to Australia to enable voyagers to receive and send messages daily throughout the trip. Negotiations are said to have been entered into for the necessary rights at Prawle Point, The Lizard, Ushant, Cape Finisterre, Gibraltar, Malta, Algiers, Sardinia, Sicily, points along the Greek coast, Alexandria (Egypt), Aden, the Coco Islands and Australian points. The promoters are said to have predicted that telegrams will be transmitted at the rate of twopence a word.

A Tacoma, Wash., press despatch states that the proposed telegraph line in Alaska, between Juneau and Skagway, will be built in the Spring. Ten thousand dollars has been subscribed by the merchants of those cities as a bonus for the builders of the line to connect it with the Dominion Telegraph system running from Bennett to Dawson in one direction, and in the other to Atlin, Ashcroft and Vancouver. Subscribers to the line will receive telegraph coupons for their money and a rate of $1.00 for 10 words will be established between Juneau and Skagway. These two cities are exactly one hundred miles apart.

An automobile contemporary prints the following paragraph relative to the use of wireless telegraphy as employed by the German forces in China: "The German forces in China have recently been provided with a six-horse-power gasoline truck for use in the operations there. The vehicle carries a direct-current dynamo and a wireless telegraphy outfit. The dynamo is driven by the gasoline engine and will furnish the current for the telegraphic apparatus. The vertical wires of the telegraphic receivers are carried by balloons of eighteen cubic feet capacity. The order for the entire outfit was filled within two weeks."

A telephone nearly a mile below the surface of the earth is somewhat unusual, but the fifty-third level of No. 5 shaft, Calumet branch of the Calumet & Hecla mine, is connected with the surface, and one can stand at the bottom of the shaft and talk to Chicago, Minneapolis, Detroit or Cincinnati, the mine telephones being connected with the long-distance service. The underground system in the Calumet's mines includes 13 telephones, most of them located at the pumping stations in the shafts at the north end of the mine. One shaft, No. 4, has instruments at the eighth, sixteenth, twenty-fourth, thirty-third and forty-first levels, and in No. 5 they are located at the eleventh, twenty-second, thirty-third, forty-first and fifty-third levels. No grounded telephones are used in the mine and connections can be had with any of the cities of the country that are reached by the overground long-distance service.

The Boston News Bureau says that the election of Mr. Charles P. Bowditch to the directorate of the American Telephone and Telegraph Company is regarded as a movement for the continuation of the conservative policy which has hitherto prevailed in its management. The vacancy in the directorate caused by President Hudson's death was not expected to be filled until a permanent president should be elected who would also be made a member of the board, but Mr. Bowditch's election is taken to indicate that a permanent president will be chosen from the present

directorate, as otherwise it would be necessary to ask the stockholders to change the by-laws regarding the enlarging of the board. Mr. Cochran is to be continued as acting president and it has been rumored that when Governor Crane leaves office he will be tendered the presidency of the company. While the largest stockholder in the company, Mr. Crane has never been officially connected with it to date, although often consulted regarding matters of general policy.

A report from Nashville, Tenn., states that the Cumberland Telephone and Telegraph Company, which recently absorbed the East Tennessee Telephone Company and other systems throughout eastern Kentucky and Tennessee, has within the past month acquired the following independent telephone systems with a total subscription list of nearly 2,000 subscribers and about a thousand miles of toll lines: Tri-State Telephone Company, of North Alabama and Georgia; Cleveland, Tenn., telephone system; Sweetwater, Tenn., telephone system; Hickman, Ky., telephone system; Elizabethtown, Ky., telephone system; Paris, Ky., telephone system; Lebanon, Ky., telephone system; Stanford, Ky., telephone system; Nicholasville, Ky., telephone system; Boyle County, Ky., telephone system. The companies named above were originally independent organizations for purely local purposes, but have gradually extended and expanded to meet the demands of the public for other services throughout the counties in which they are located, and will now be brought under one management and so connected that from local they will become practically short long-distance lines, and intercommunications will be thus assured.

Wireless Telephony at Minneapolis, Minn.

Experiments were made recently in wireless telephony across the Mississippi River, near the Franklin avenue bridge, at Minneapolis, Minn., and were regarded as very successful. One hundred and fifty feet of copper wire were strung in parallel lines on either side of the river and the first experiment was tried with a pressure of five volts. It is stated that words could be as distinctly understood across the river as by means of a regulation wire instrument, the distance being something over a thousand feet. Other batteries were then attached, five at a time, eventually cutting in 20 volts on one end of the line with five on the other. The operator at the low-pressure end could not only understand what was being said to him, but could hear others than the operator talking on the river bank opposite, near the transmitter.

The Bullock Electric Manufacturing Company.

The Bullock Electric Manufacturing Company, of Cincinnati and New York, has purchased the Oerlikon alternating-current patents for this country and will soon be prepared to manufacture on a large scale. Apparatus ranging in size from one-fourth horse-power to 2,000 kilowatts will soon be ready for the market. Mr. B. A. Behrend will have charge of the alternating-current engineering for this company. Among the recent contracts is one with the McCloud River Electrical Power Company, the transmission being from McCloud River to Keswick, Cal., a distance of 35 miles. The contract with the Bullock company includes all of the electrical apparatus for the entire work, and there will be four 500-kilowatt units, three-phase, 60-cycle alternators of the revolving field type. These are to be driven by Stilwell-Bierce & Smith-Vaile Company twin turbines. The voltage of the line will be 32,000 and step-up transformers will be used at the generating station; step-down transformers will be used at the receiving station, reducing the voltage to that required.

X-Rays Detect Postal Smuggling.

A Mexican cable despatch states that a curious experiment was made at Buenos Ayres, Argentine Republic, in the post office, with Roentgen rays. In the incoming mail were about eighty parcels directed to importers of jewels, which were supposed to contain watches and diamonds. The importers protested against the opening of the packages and refused to pay duty, but the post-office officials were obdurate and finally exposed the suspected packages to the light of the X-rays, which showed that all of the parcels contained valuable jewelry, such as watches and diamonds. The importers were then compelled to pay duty or forfeit the goods.

OBITUARY.

Robert T. Tighe, 58 years old, died recently at his home on West 104th street, New York, the cause of his death being a ruptured blood vessel in his chest. Mr. Tighe was born in Dublin, Ireland, in 1842, and came to the United States in 1852. He served through the Civil War in the Fortieth New York Regiment, participating in 15 battles, being twice wounded. After the war he constructed interstate telegraph lines for the South American countries, receiving from their governments marked favors. He was one of the most expert telegraphers in the world. A widow and five grown children survive him.

A New Storage Battery for Electromobiles.

Mr. Elmer E. Sperry, of Cleveland, Ohio, who is well known as an electrical inventor, has designed a new storage battery especially for use with electromobiles. His series of patents covering the invention have been acquired by the American Bicycle Company, who will use the batteries in their electric vehicles. Mr. R. Lindsay Coleman, president of the American Bicycle Company, in speaking with a representative of the ELECTRICAL REVIEW, confirmed the report that his company had obtained the exclusive rights to Mr. Sperry's storage battery inventions. The battery is extremely light and simple in construction, and it is claimed, has driven a heavy automobile carriage over 100 miles of country road on one charge. Its chief advantages are claimed to be its cheapness of manufacture and repair. Mr. Sperry has been appointed principal electrician of the American Bicycle Company, and two of the company's factories have been remodeled for the rapid construction of the batteries, which at first will be used only on vehicles of their own make.

Roentgen Society Meeting.

The Roentgen Society of the United States held its annual meeting at the Grand Central Palace, New York city, on December 13 and 14. Twenty-one papers were presented altogether, and a practical demonstration of the value of the X-rays was made by throwing Roentgen photographs on a screen with a stereopticon. In one room, on the fifth floor, the papers were presented to an interested audience of both theorists and practitioners, while in another were the exhibits of a number of dealers. In the latter room the air was full of snapping noises, ghostly lights, and buzzings, while enthusiastic visitors looked through dark fluoroscopes, and talked enthusiastically of "interrupters, and coils, and currents, and things."

An Automobile Show at Washington, D. C.

Another automobile show has gone into the list of past events. This time it was held in Washington, D. C., at Convention Hall. The week's exhibit was very successful. A large crowd was in attendance, and the affair is regarded as highly satisfactory.

Mr. A. C. White, general manager of the Providence Telephone Company, was a New York visitor last week. Mr. White hails from the state that is famous for its Thanksgiving turkeys, and several of his electrical friends in New York have reason to be quite appreciative of this fact.

New York Electrical Society.

Dr. Samuel Sheldon, professor of electrical engineering at the Polytechnic Institute, of Brooklyn, N. Y., read a paper on "Electrical Measurements of Precision," at the two hundred and tenth meeting of the New York Electrical Society, in New York city, on December 12.

Dr. Sheldon divided his classification of measurements into two groups, viz., commercial measurements and measurements of precision. Commercial determinations of hysteretic constants, of dielectric strength and installation resistance are subject to errors of 10 per cent, 20 per cent, and 25 per cent, respectively, while comparisons of standard resistance as well as current and electro-motive force meters are figured with the greatest accuracy, no errors greater than one one-hundredth of one per cent being permissible.

After the lecture some 50 lantern slides were exhibited by President Martin, the views being chiefly those taken at night, illustrating lighting effects at the Paris Exposition. Both day and night views of the same scenes were exhibited, and considerable attention was paid to the details regarding the manner in which the effects were obtained. A critical comparison was made between the Parisian views and the same sort obtained at Chicago, Atlanta and Omaha.

At the conclusion of the meeting the society adopted the following resolutions relative to the formation of a national standardizing bureau:

WHEREAS, it is proposed to establish a national standardizing bureau, and

WHEREAS, such a bureau would be of the greatest value and benefit to electrical science and industry in the United States, and assist in the further development of export electrical trade, be it

Resolved, that the New York Electrical Society hereby expresses its approval of the legislation in furtherance of such an object, and

Resolved, that the Society associate itself with kindred bodies to secure the establishment of the bureau.

American Institute of Architects.

The thirty-fourth annual convention of the American Institute of Architects was held at the Arlington Hotel, Washington, D. C., December 12 to 15, 1900. The convention was opened with an address of welcome by Mr. H. B. F. Macfarland, president of the Commissioners of the District of Columbia. Mr. Robert S. Peabody of Boston, president of the institute, delivered an entertaining and instructive address. Reports were received from the board of directors and the chapters of the association, as well as a number of special committees on matters connected with the profession. These all showed the work of the institute to be in a very healthy condition. The report of the treasurer showed the receipts during the last year to be $6,038.37, and expenses $5,372.78, leaving a balance of $665.59.

The meeting was largely given up to a consideration of the esthetical side of architecture, and the papers on English, French, Italian and American Gardens were highly interesting. These were illustrated by lantern slides.

The present officers were reelected: President, Robert S. Peabody, Boston; 1st vice-president, W. S. Eames, St. Louis; 2d vice-president, Frank Miles Day, Philadelphia; secretary and treasurer, Glenn Brown, Washington. Directors, to serve three years: John Carrere, New York; James McLaughlin, Cincinnati; R. C. Sturgis, Boston. The next meeting will be held at Buffalo, N. Y.

Wall Street and the Electrical Stock Market.

On the New York Stock Exchange, General Electric closed the week at 171¾ bid and 172 asked, showing a gain of 2⅛ points. Metropolitan Street Railway, of New York, closed at 168½ bid and 168¾ asked, indicating a gain of 3¾ points. Brooklyn Rapid Transit closed at 75¼ bid and 75½ asked, showing a gain of 5 points for the week. Third Avenue Railroad closed at 115 bid and 116 asked, indicating a gain of ½ point. Manhattan Railway, of New York, closed at 110¾ bid and 110⅞ asked, showing a gain of 2⅞ points for the week.

On the Boston exchange, American Telephone and Telegraph closed at 156½ bid and 157 asked, showing a gain of 1½ points in the asked price. Erie Telephone closed at 101 bid and 103 asked, indicating a loss of 3 points for the week, or 6½ points for the past two weeks.

On the Philadelphia exchange, Electric Storage Battery was not quoted. Electric Company of America closed the week at 8⅞ bid and 9 asked, showing no change in either price for the week. Union Traction closed at 36⅛ bid and 36⅜ asked, indicating a gain of 1⅝ points for the week.

On the curb, or outside market, in New York, Electric Vehicle closed the week at 16½ bid and 19 asked, indicating a loss of 3 points. Electric Boat closed at 26½ bid and 28 asked, showing a gain of 3½ points for the week. Consolidated Equipment closed the week at 11¾ bid and 11½ asked, indicating a gain of ¼ point.

Wall street, December 15.

PERSONAL.

Mr. Alexander Henderson, of the Sprague Electric Company, returned to New York city last week after an extended business trip through the West.

Mr. C. W. Woodward has been appointed purchasing agent of the Electric Storage Battery Company, Philadelphia, to succeed the late John B. Falkner, Jr.

President A. A. Wright, of the Renfew Electric Company, of Canada, has been elected to the House of Commons. Mr. Wright is said to be the only member of the Dominion House who represents electrical interests.

The General Traction Company, Paris, France, has obtained the services of Mr. Duncan McDonald as superintendent. Mr. McDonald is a Canadian, and at present superintendent of the Montreal Street Railway Company.

Mr. George W. Edwards, general superintendent of the elevated division of the Brooklyn Rapid Transit Company, has resigned. Mr. Edwards has been connected with the elevated systems of Brooklyn since their beginning.

Mr. H. J. W. Dam, a former well-known member of the Electric Club, of New York, and for the past 13 years a resident of London, is visiting New York and will spend a couple of months in the United States. Mr. Dam is a popular and technical writer of eminence and has recently formed a partnership with David Belasco, and the firm will soon bring out a number of new plays.

Mr. Lee H. Parker sailed from New York for England on Wednesday of this week, on his way to Buenos Ayres, where he has been doing some important electric railway work. Mr. Parker has been visiting the States for a few weeks on both business and pleasure. He was for several years in the electric railway department of the General Electric Company, and was prominently connected with the installation of the electric locomotives in the Baltimore & Ohio Railroad tunnel at Baltimore.

Disastrous Conflagration at Cleveland, Ohio.

Fire completely destroyed the plants of the Brown Hoisting and Conveying Machine Company and the Elwell-Parker Electric Company, early in the morning of December 17. The loss is very heavy, reaching nearly $1,000,000. Cleveland's firemen were unable to control the flames on account of the wind which blew a gale and hampered them greatly.

Electric Omnibus Line in City of Mexico in Service.

One of the first cities in the world to maintain an electric omnibus line in regular service is the City of Mexico, which has recently inaugurated such a system. Mexico has never been regarded as a very promising field for the exploitation of electrical enterprise on account of the tightness of money there, the high rate of the bank discount, and the fact that most of the reported developments are "en las nubes" (in the clouds), as the Mexicans say.

Unscrupulous boomers have repeatedly circulated glowing reports of the rapid advance being made in Mexico by the electrical arts, but for the most part these were merely schemes to lure the dollars from unwary pockets, pockets whose owners were ignorant of the true conditions.

Mexico is, however, progressing as rapidly as is consistent with her circumstances, and the fact that an electric omnibus line has been established in her capital is good evidence of her enterprise. Under date of December 4, the Mexican *Herald* says:

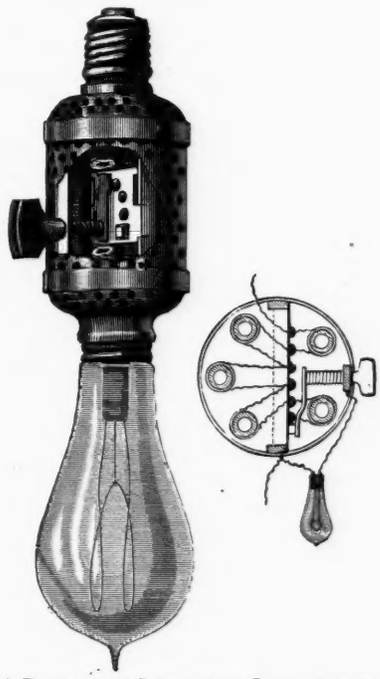
The new automobile omnibus service, between the National Palace and the Statute of Carlos IV, was subjected to a severe test on Saturday and Sunday last, when the streets of Plateros and San Francisco were crowded to their utmost capacity with people on foot and vehicles of all kinds. The new service must be given credit for having kept up a service of regular and frequent trips during all that portion of the day when vehicles were permitted on the streets named. Every omnibus was filled to its utmost capacity, and, in spite of the immense crowd, thousands of people were transported from one end of the route to the other, not only pleasure seekers who were viewing the illuminations, but people who wished to go to and from their homes. Not one accident took place during either of the two days, thus giving a practical demonstration that the automobile is the most easily managed of any public vehicle in use.

The omnibusses presented a gay appearance draped with the national colors, and on Saturday night they were illuminated by red, white and green electric lamps, which added to the festive appearance of the streets.

The extension of this excellent service through other important streets of the city may be expected when the sewerage repairs are finished and the new asphalt pavements are laid.

A Regulating Socket for Incandescent Lamps.

The accompanying illustrations represent a new and ingenious regulating socket for incandescent lamps which the makers, the G. F. Brunt Porcelain Works, of East Liverpool, Ohio, claim accomplishes its work at a considerable efficiency so that when the light is burning low the current consumption is correspondingly lowered. Tests have been made on the device in question with a number of lamps of different types and these are highly interesting. The socket is provided with a number of steps representing different intensities of light. There are five intensities less than the full candle-power. In a test with a 52-watt 110-volt lamp, the watts consumed by the whole device varied from 52 down to 31 in passing through the various steps. A very interesting test made on a 110-volt 16-candle-power lamp of four watts efficiency showed the following results: At the first position the lamp took 63 watts and gave 16 candle-power; at the second position it took 55 watts and gave 7.6 candle-power; third position, 48 watts, 3.8 candle-power; fourth position, 43 watts, 1.8 candle-power; fifth position, 38 watts, 0.8 candle-power; sixth position, 33 watts, 0.4 candle-power. On another 110-volt lamp the saving of current consumed on the various steps ranged up to nearly 40 per cent on the last step, while moderate dimming of the light, such as would be useful in a sick room, for example, showed a saving of 26 per cent. It is intended that this lamp shall be used in situations where it is desired to turn down the light and thus to remove from the incandescent lamp the only objection that householders have entertained regarding it.



A Regulating Socket for Incandescent Lamps.

Large Power Plant in Shasta County, Cal.

With a capital of $750,000 the Beckwith Power Company proposes to install a large electric light and power plant in northern Shasta County, to supply power to all the operating lines in that section as well as cities and towns in the vicinity. The company is composed of a number of San Francisco, Oakland, Sacramento and Colusa capitalists, who own or control six water locations, some of which are in the sugar pine forests near Shingletown, and will develop at least 30,000 horse-power.

A traction company which intends to build a railroad line from the most available point on the Sacramento River to the sugar pine forests, near Shingletown and Plateau, is said to be closely affiliated with the former company and will be controlled by eastern capitalists who have obtained options on large tracts of valuable lumber lands. Work will be begun on the lighting and power plant about the first of the year and on the railroad line in the Spring, as soon as the snow is out of the mountains.

It Jarred Him.

The sun was bright, the sky aflame, as down Third avenue there came the "Black Maria" with its load of one lone vagrant who abode in sleepy comfort as he rode. The driver, James McGrath by name, unknown alike to wealth or fame, urged on his team of naught afeared until a trolley car appeared, and then the lovely picture dreared.

"Maria" reeled and struck the "L," her sombre wheels all smashed to——well, I wouldn't like in print to say just how they went or where away; *satis* "Maria" was not gay. McGrath was hurled a dozen feet from off his pleasant cushioned seat; when he arose the car had passed, "Maria's" slats were weirdly massed, a tangled jumble, badly cast.

"The prisoner! Is he dead or gone?" the driver cried with visage wan. He rushed around and soon espied the hobo resting safe inside, uninjured and unhurt beside.

"Art hurt?" Mc Grath wept in his fear; "Aw nit," the answer came full clear. "But let me out, sir, please, please do, and by the way of something new, didn't this smashup just jar you?"

Corporation News

INDIANAPOLIS, IND.—Merchants of Dana have incorporated the Indiana Electric Company for $13,500.

INDIANAPOLIS, IND.—A recent incorporation is that of the Pennville Telephone Company, with a capital of $2,000.

KANSAS CITY, MO.—A charter has been granted to the El Dorado Springs Telephone Company, which is capitalized at $10,000.

VICKSBURG, MISS.—A charter has been granted to the Southern Light and Power Company, of Vicksburg, with a capital of $100,000.

HARRISBURG, PA.—Corporation articles have been granted to the Juniata & Susquehanna Telephone Company. The capital stock is $1,000.

AUGUSTA, ME.—A charter has been granted to the Lewiston, Winthrop & Augusta Street Railway Company, with a capital stock of $160,000.

PUEBLO, COLO.—The Colorado Springs Electric Company, to construct and operate electric lines, has been capitalized at $1,000,000 by local investors.

TRENTON, N. J.—New York capital is interested in the Keystone Wagon and Automobile Company, which has been incorporated in this city for $100,000.

CHICAGO, ILL.—The National Manufacturing and Electric Company, of Assumption, has been granted a charter with a capital of $25,000.

ALBANY, N. Y.—New York city capitalists have incorporated the Whitehall Gas and Electric Company for $50,000 to supply gas and electricity for light and heat.

NATCHEZ, MISS.—A charter has been granted to the Natchez Electric Street Railway and Power Company, which is capitalized at $15,000. Local capital is heavily interested.

ALBANY, N. Y.—The Hamburg Electric Land Company, of Buffalo, was incorporated on December 6. Its capital is $7,770 and its incorporators are all Rochester capitalists.

SPRINGFIELD, MASS.—A recent incorporation under Maine law is that of the Skene American Automobile Company, whose capital stock is $500,000, $250,000 of which is paid in.

DETROIT, MICH.—A new automobile company has been chartered in this city and will operate as the Rambler Cycle and Automobile Company. The charter calls for a capital of $25,000.

AUGUSTA, ME.—The York County Railroad Company was incorporated on December 3 at Augusta, for $250,000. This amount will be divided into 2,500 shares of common stock.

AUSTIN, TEX.—A charter has been granted to the Bryan Telephone Company, which is capitalized at $12,000, to operate in Brazos, Burleson, Robertson, Madison and Leon counties.

INDIANAPOLIS, IND.—Vermilion County capitalists have incorporated the Indiana Electric Company, with a capital stock of $13,500, to operate telephone lines in Indiana and Illinois.

MEDINA, N. Y.—Augustus H. Vanderpoel has been appointed permanent receiver of the Medina Gas and Electric Light Company, in proceedings for the dissolution of that corporation.

CAMDEN, N. J.—The New Jersey Light, Heat and Power Company was incorporated at Trenton, on November 28, with a capital stock of $200,000, to furnish electric light, heat and power.

NEW BRUNSWICK, N. J.—Incorporation articles were recently granted to the New York Electric Supply Company, which was capitalized at $50,000. The new corporation will have an office at Carteret.

JEFFERSON CITY, MO.—A charter was granted on November 30 to the Sikeston Telephone Company, with a capital of $12,000, and the Saline County Telephone Company increased its capital stock by $10,000.

TRENTON, N. J.—A charter has been granted to the Transcendent Light Company, of Jersey City, to furnish light, heat and power. The capital stock is $300,000, furnished by New York and Jersey City interests.

ALBANY, N. Y.—Incorporation articles have been granted to the Waterford Electric Light, Heat and Power Company, capitalized at $50,000, to do business in Waterford, Schaghticoke, Stillwater and other towns in the vicinity.

MCKEESPORT, PA.—A press despatch states that the McKeesport, Wilmerding & Duquesne street railway, and the Yoghioghany Valley Traction Company have been absorbed by the Monongahela Street Railway Company for $600,000.

SPRINGFIELD, OHIO—Articles of incorporation have been issued for the Little Miami Traction Company, whose capital stock is $50,000. This will eventually be increased to $2,500,000, and a railway will be built from Springfield to Cincinnati, touching several intermediate points.

BOSTON, MASS.—A hearing was given to the proposition of the Pembrook street railway for authority to issue $270,000 in first mortgage bonds to retire the bonded indebtedness of the Plymouth & Kingston street railway, which it absorbed, and to issue $80,000 additional capital stock. No opposition was manifested and the matter was favorably reported upon.

NEW YORK CITY—G. R. Gray Company was incorporated on December 7 for $5,000 to do a general electric equipment business, and on the same date in Wilmington, Del., a charter was granted to the United Electric Light and Power Company, also of New York, to furnish electric light, heat and power. The latter company's capital stock is $1,500,000.

LANSING, MICH.—An increase of $30,000 to its capital stock has been certified by the Wolverine Motor Works, of Grand Rapids. On December 2, charters were granted to the Toledo, Adrian & Jackson Railway Company, of Toledo, Ohio, capitalized at $70,000, and the Low Water Electric Alarm Company, of Detroit, $25,000 capital stock.

LANSING, MICH.—Incorporation articles have been granted to the Pontiac & Flint Electric Railway Company, which is capitalized at $50,000. Minnesota and Michigan capital is interested. The object of incorporation is to construct an electric road 32 miles in length from Pontiac to Flint to connect with the Saginaw Suburban, now in process of construction.

NEW BRUNSWICK, N. J.—Andrew Radel, prominent in the Middlesex-Somerset Traction Company, has recently purchased the Akron & Cuyahoga Falls Rapid Transit Electric Railroad, of Ohio, and expects to spend about $25,000 in improving and extending the system. Mr. Radel refused to name the purchase price, but it is believed it reaches well up into the hundred thousands.

NEWARK, N. J.—A consolidation of the trolley companies in Elizabeth, Rahway and Plainfield, excepting only the North Jersey Street Railway Company's system in Elizabeth, has been effected. The new corporation will be known as the Elizabeth, Plainfield & Central Jersey Railway Company, with a capital stock of $3,000,000. A bond issue of $2,500,000 has been authorized to provide for extension of the system. The president of the new company is David Young, of the North Jersey Street Railway Company; vice-president, Thomas A. Nevins, of Orange; treasurer, Thomas N. McCarter, and secretary, Colonel Edwin W. Hine, of Orange. The companies included in the consolidation are: The Westfield & Elizabeth Street Railway Company, the Elizabeth City Horse Railroad Company, the Elizabeth Street Railway Company; the Plainfield Street Railway Company and the Rahway Street Railroad Company. The lines extend, with branches, to Dunellen, Westfield, Rahway, Boynton Beach, Plainfield, Roselle, Scotch Plains and North Plainfield. Both of the Elizabeth companies were owned by United States Senator John Kean, whose interests are bought outright by the new corporation. Of the $2,500,000 bond issue, $1,500,000 will apply to the purchase of the Kean interests and those of the Rahway company. The rest will be spent in improvements and extensions to the system. Among the extensions projected are lines to connect Cranford, Springfield and Millburn. It is said through cars will soon be run between Newark and Plainfield.

A Twenty-Five Million Dollar Contract.

American bids are prominent in tenders presented to the Metropolitan District Underground Railway Company, of London, England. The company has invited plans and estimates for the conversion of its lines from steam to electric motive power, and the extraordinary size of the contract, which contemplates the entire reconstruction of over 50 miles of underground railroad, calls for a gross expenditure of about £5,000,000, or $25,000,000.

The principal bidders for the work are the Westinghouse Electric and Manufacturing Company, and the General Electric Company, from the United States. Germany will be represented by the Allgemeine Elektricitäts Gesellschaft, Siemens Brothers, Schukert & Company and Felton & Guilleaume; while the French bidders are the Bregguet Electrique Cie, and Houtin et Leblanc. The British competitors are all prominent firms, including the Brush Electric Company, Dick Kerr & Company, Mather & Platt, Thomas Parker & Company and Crompton & Company.

It is stated that American manufacturers, relying on the prestige they obtained from having successfully built the London central "Tuppenny Tube," expect the lion's share of the work. Sir William Preece, consulting engineer to the railway, recently remarked regarding the award of the contracts: "Owing to the fact that we have not hampered the bidders with specifications of any kind, we expect to be tendered a scheme for the best system of electric traction which modern ingenuity is capable of devising. We possess facilities for a service of 22 trains an hour, and all we ask is a plan of operation which will test our capacity to the utmost. That the United States will be prominently represented goes without saying. That country is the pioneer of all that is good and great in electrical science, and in the application of it she is not to be surpassed."

Columbia Incandescent Lamp Company's New Offices.

The Columbia Incandescent Lamp Company, of St. Louis, has just completed arrangements to open a branch office in Philadelphia, at 1227 Real Estate Trust Building, Broad and Chestnut streets, to meet the requirements of its increasing business in that section of the country, and has engaged the services of Colonel D. H. Garrett as manager, who will have charge of the office. Colonel Garrett has been identified with the incandescent lamp business for some years past and is well known in Philadelphia and the surrounding territory. It is the company's intention to carry a considerable stock of lamps in Philadelphia, and it will be in a position to give prompt attention to the demands of its customers.

The Columbia Incandescent Lamp Company has also made some changes in its Minneapolis offices, which are now located at 823 and 829 Guaranty Building. The company's business in the Northwest has shown a handsome increase during the past year and for the benefit of customers in that territory a large stock of Columbia lamps will be carried at the Minneapolis office.

Diehl Manufacturing Company's Fan Patents Again Sustained.

A decree was entered on December 5, in the United States Circuit Court for the Eastern District of Pennsylvania in a recent action of the Diehl Manufacturing Company, of Elizabethport, N. J., against the Marietta Manufacturing Company and H. Burd Cassel, receiver, for infringement of the following patents relating to electric ceiling fans: Nos. 465,360, of December 15, 1891; 465,361, of December 15, 1891; 537,679, of April 15, 1895, and 585,250 of June 29, 1897. This decree declares these patents to be valid and to have been infringed by the Marietta company, and orders, "that a perpetual injunction be issued in this suit strictly commanding and enjoining said defendants and each of them and their servants, agents, attorneys, employees, workmen and confederates and each and every of them from directly or indirectly making, constructing, using, vending, delivering, working or putting into practice, operation or use, or in any wise counterfeiting or imitating the said inventions as set forth in and patented by said Letters Patent or either of them, or any of the claims of them, or either of them, without the consent of the complainant."

Transportation Advertising.

At a recent meeting of the Sphinx Club, of New York, Mr. George H. Daniels, general passenger agent of the New York Central & Hudson River Railroad, delivered an interesting and thoughtful address on transportation advertising, in which he reviewed the question of advertising in general at some length. He expressed an abiding faith in newspaper advertising as against sign boards, and expressed his belief that no enterprise of to-day could become a well-rounded success unless a large advertising expenditure was carefully and intelligently utilized. He paid a just tribute to the transportation companies of this country for the interesting literature they were constantly publishing and which they were at constant pains to keep accurate and up to date. Mr. Daniels stated that over $1,500,000 was spent last year by 15 of the leading steam roads of this country for advertising alone.

New Offices of the Morris Electric Company.

It is with justifiable pride that the Morris Electric Company tells its friends of its new offices at 15 Cortlandt street, New York. The building is the same the company has occupied for some time past, but the offices are entirely changed, to accommodate the rapidly increasing business of the company.

The offices comprise an entire suite of eight rooms, two of which are large, double apartments. They are light, airy, and impress one with a sense of comfort and utility—a pleasant place for a busy man to do business in.

Though scarcely more than settled in its new quarters as yet the company is doing an ever increasing business, and the new offices wear a very busy look. The ELECTRICAL REVIEW extends its congratulations and best wishes for a prosperous future.

Puerto Rican Manufacturing Concessions.

A valuable franchise has been recently granted to Ramon Valdez, of San Juan, Puerto Rico, which gives him the water rights of the Rio Plata, 15 miles distant from the city. A sufficient power is available there for lighting the entire city, for manufacturing purposes and for the operation of a trolley system. Señor Valdez is said to be negotiating with the Rio Plata Electric Company for the sale of his rights and if he is successful it is believed that the company, in which Philadelphia, Pa., capital is invested, will expend about $400,000 in new developments.

The tax assessors of New Jersey recently admitted their error in neglecting to assess the property of the North Jersey Street Railway Company as real estate, and will show that the intrinsic value of the taxable property is something like $1,300,000. The figures named are those of the president of the road, who is willing that the personal assessment should be changed to a real estate charge.

Industrial Notes

SAMUEL J. SMITH & COMPANY, Charlotte, N. C., have issued a neat blue folder advocating the purchase of their electrical supplies.

THE AMERICAN BRIDGE COMPANY, New York city, will erect the new power station of the Grand Rapids Company, of Grand Rapids, Mich. The station will measure 147 by 111 feet.

THE WESTERN ELECTRIC COMPANY, Chicago, has just shipped a large number of its "Petite" direct-current arc lamps to Australia, and a number of its series enclosed arc lamps to South America.

PETTINGILL & COMPANY, 22 School street, Boston, Mass., have issued a neatly bound pamphlet, "The Science of Advertising." The book is printed on heavy paper, bound in black board and stamped in gold.

THE GILMORE ELECTRIC COMPANY, South Boston, Mass., has issued a 32-page folder of its series multiple and miniature incandescent lamps and rosettes. The book will be sent, upon application, to interested parties.

THE SHELBY LIGHT AND POWER COMPANY, Shelby, N. C., whose incorporation was recently noted in these columns, has an order for generators and transformers with the Royal Electric Company, of Peoria, Ill.

"PROFITABLE ADVERTISING" has come out with a special number of unusual interest, containing a number of good features, including color plates of a striking order. The publisher is Kate E. Griswold, 227 Washington street, Boston, Mass.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is sending out a "reply" postal card of interest to users of 60-cycle alternating current, asking information regarding voltage and alternations of central stations throughout the country.

THE CARY SPRING WORKS, of 240 and 242 West Twenty-ninth street, New York city, is manufacturing some new styles of its wire springs. These springs are widely used in machinery, motors, clocks, music boxes, etc., being highly tempered and strong in construction.

THE AMERICAN BICYCLE COMPANY, Hartford, Ct., has issued its 1901 edition of the Columbia desk calendar. This publication has been issued annually for the last 16 years and is a neat and useful accessory to any desk. It will be sent to any address for five two-cent stamps.

MR. AUGUST BECKER, of 34 Oliver street, Boston, Mass., is sending out among the trade some very artistic name-plates. The name-plates manufactured by him are used in great quantities in a large number of dynamo and motor plants throughout the United States, and have proven very satisfactory to the trade in general.

THE MONTAUK MULTIPHASE CABLE COMPANY, of 100 Broadway, New York city, has recently introduced its well-known multiphase cable in a number of private dwellings, where the necessity for quick protection in case of fire exists. The cable is quick and accurate in its action, and will detect a fire almost immediately.

THE AMERICAN VITRIFIED CONDUIT COMPANY, 39-41 Cortlandt street, New York city, has recently received several very large orders for its vitrified conduits for underground work. The conduit is vitrified and highly glazed, and, it is claimed, will last a long period of time. It is said to be impervious to the action of the earth.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is extremely proud of the fact that the Packard lamps were adopted by the Government to light the Paris Exposition. The company states that these lamps are being adopted by a greater number of users in both the local and foreign markets than ever before in their history.

THE HOLOPHANE GLASS COMPANY, of 15 East Thirty-second street, New York city, is manufacturing some new styles of its compound prism globes and shades. These shades are intended for both incandescent and arc lighting, and the company claims that they will diffuse the light without causing the glare customary in the uncovered electric light.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, of Philadelphia, will supply, upon request, printed literature relating to switchboard and portable voltmeters, ammeters, ground detectors and other measuring instruments. This company is meeting with large patronage in this field, and is receiving many compliments over the excellence of its products.

THE GOULD STORAGE BATTERY COMPANY, of 25 West Thirty-third street, New York city, announces that its storage battery used in electromobiles has proven valuable on account of its lightness and durability. These batteries are also adapted for electric elevators, railroad signal apparatus, telegraph, telephones and electric fire-alarms, and are of high efficiency.

AN ARTICLE OF NOTE in the January number of *McClure's Magazine* will be entitled "Great Achievements in Modern Bridge Building," by Mr. Frank W. Skinner, of *The Engineering Record*. Here are sketched vividly the chief bridges of recent times and the manner of their building. The text is enriched by illustrations from photographs and a page drawing by Mr. George Varian.

THE "AUTOGAS" DRY BATTERY, manufactured by William Roche, of 42 Vesey street, New York city, is attracting considerable attention in the automobile field, where a dry battery is used to give the spark that starts the operation of the vehicle. He states that the dry automobile cell is made in the same size as the French cell, and is so manufactured as to admit of its operation on any system.

GRAPHITE, published by the Joseph Dixon Crucible Company, Jersey City, N. J., has come to hand and contains a cut captioned "You Can With a Can," illustrative of the fact that Dixon's pure flake graphite may be used in an ordinary dry squirt oil can; when a coarser flake graphite is used, a larger opening in the nozzle of the spout is required. If the can is used dry any size of the flake graphite may be used.

THE KNEELAND REFLECTOR COMPANY, of 222 Friend street, Boston, Mass., is shipping a large quantity of its various sizes and styles of reflecting shades. This company is manufacturing a hood shade, a desk shade and a disk shade, in all sizes, in silver, green bronze or green enamel. The manufacturers claim that these shades are very popular throughout the electrical field, and many are in use in large office buildings and factories.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has issued a pamphlet entitled "A Decade in a Wonderful City—A few Facts About Cincinnati," quoting from Horace Greeley's statement that "It requires no keenness of observation to perceive that Cincinnati is destined to become the focus and mart of the grandest circle in manufacturing thrift on this continent." The book is tastefully gotten up in blue covers and printed throughout in pale blue ink.

C. W. HUNT COMPANY, West New Brighton, S. I., has issued a neat booklet entitled "Coal Handling for Steam Generation." The book contains a large number of cuts illustrating the company's apparatus and giving views of several large plants, both in the United States and abroad, where its apparatus is installed. The company manufactures industrial railways, electric locomotives, coal-handling machinery, conveyors, steam and electric hoisting engines and manila rope. Its New York office is at 45 Broadway.

THE NEW YORK CENTRAL RAILROAD COMPANY, New York city, has in its service a redemption bureau for unused tickets. The agents are authorized to redeem tickets sold at their offices which bear no evidence of having been used if presented by the purchaser within 30 days from date of issue. In other cases the purchaser will receive a settlement by check or postage where application is made by mail. The company states that from 10,000 to 12,000 claims are received by mail annually and an average of 10,000 are presented in person, the value ranging from a few cents to $200 apiece, and the amount of money refunded for such unused tickets aggregating $50,000 per year.

THE "RECTI" BELL, which is manufactured by Edwards & Company, of 5 and 7 Dey street, New York city, may be placed on the outside of a vehicle without being cased. The gong is adjusted with the concavity downward, so that mud and dust can not collect and deaden the sound. The vibrations are rapid and regular. The hammer rod operates in a straight line through the case and does not project, so that it is not possible to bend it. It is not pivoted, but is thrown by an armature and is entirely enclosed, making it water, dust and insect-proof. The contact points are made of carbon and will not oxidize nor corrode. They are made in sizes of from 3 to 14 inches.

THE ST. LAWRENCE POWER COMPANY, Massena, N. Y., and 40 Wall street, New York city, has issued a very handsome book containing several fine engravings and descriptive matter of its large plant at Massena. The engravings show the Long Sault Rapids of the St. Lawrence River, maps of the islands and surrounding country, the power-house of the company, both interior and exterior views, the 408-foot single-span highway bridge at the St. Lawrence Ridge Cut, a view of the canal during its construction and miscellaneous pictures, ending with a view down the Grasse River from the power-house. The book is tastefully gotten up on heavy calendered paper, printed in black, with red notations in the margin, the whole being bound in a neat deckle-edge gray cover, stamped in white ink.

THE STOREY GENERAL ELECTRIC COMPANY, successor to the Storey Motor and Tool Company, has just completed the removal of its offices and factory from Trenton, N. J., to a larger and newly equipped factory at Harrison, N. J. The new company, which is capitalized at $3,500,000, is the outgrowth of the steadily increasing demand for the well-known Storey motors, and with the larger facilities in shop room, machinery, etc., which are at its disposal, it will soon be in a position to handle a much greater volume of work in the same lines as those previously followed and also to take up a number of additional lines which it was impossible to handle before on account of the lack of proper facilities. Mr. I. E. Storey, the former proprietor of the Storey Motor and Tool Company, is president of the new concern, and has associated with him men who have both ability and capital to push the new company forward to a prominent position in the electrical manufacturing field.